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Engineering and Mining Journal

With which is consolidated Mining and Engineering World

Volume 103, No. 6
Issued Every Saturday
Hill Publishing Company

NEW YORK, FEBRUARY 10, 1917

Price, 15 Cents
Contents, First Page
Advertising Index, Last Page

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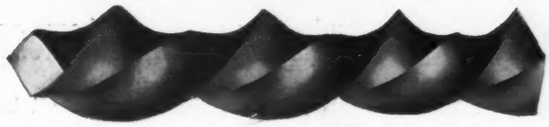

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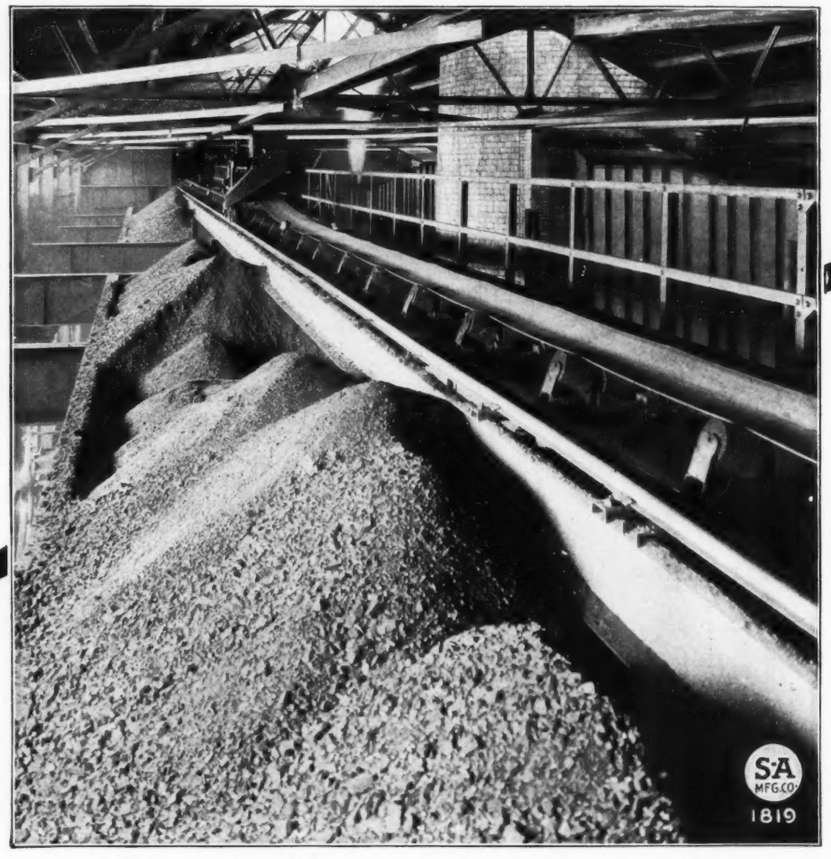

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Engineering and Mining Journal

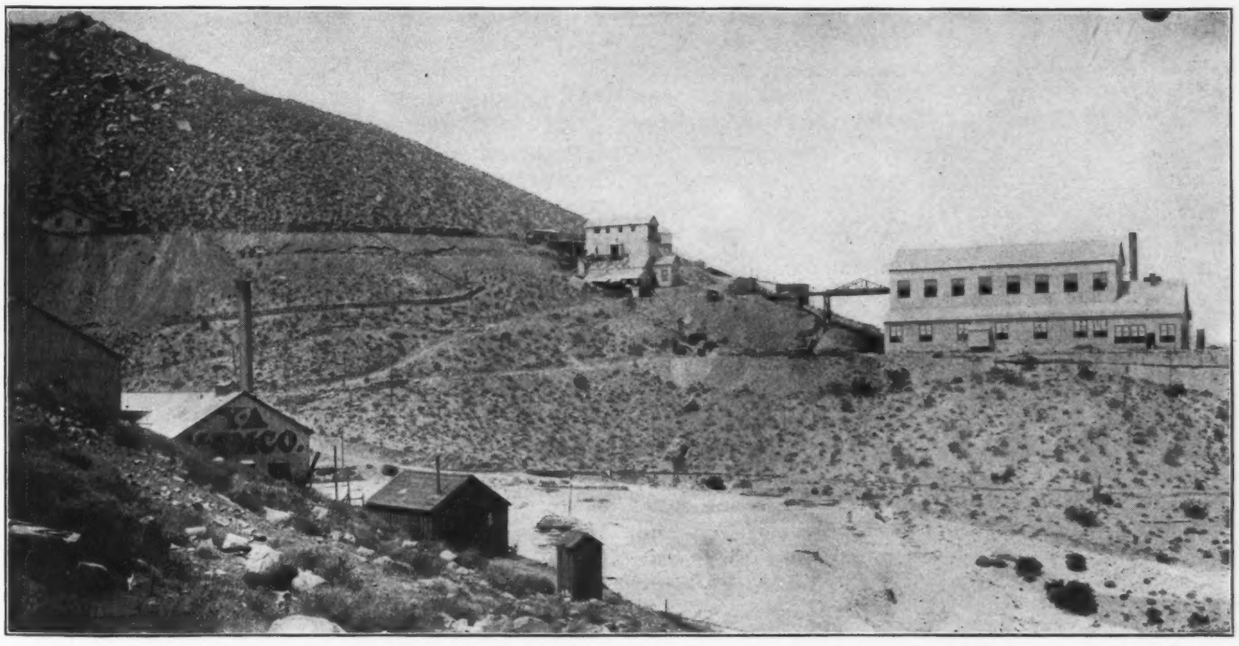
VOLUME 103 FEBRUARY 10, 1917 NUMBER 6

Twenty-One Years' Mining at Yellow Aster

By Lewis H. Eddy*

SYNOPSIS—A granite slab that looked like a tombstone to three prospectors in the Mojave Desert was the discovery rock of the Yellow Aster mine, which has produced more than $8,000,000 in gold and paid more than $1,000,000 in dividends; founded a town and opened a gold-bearing district that is the largest aggregate producer in southern California; installed stamp mills, developed water wells and created the demand that secured electric power and light for three camps—Randsburg, Johannesburg and Atolia—and the mines in these districts.

The Yellow Aster mine at Randsburg, Calif., has been in continuous operation since its discovery 21 yr. ago and has produced a total of $8,424,577 in gold and paid $1,205,789 in dividends in 18 yr. The ore occurs in a schist area as masses of broken granite, quartz veins and stockworks. At present it is mined by the glory-hole method and treated by crushing and straight amalgamation in a 100-stamp mill electrically driven and supplied with water electrically pumped from wells developed by the company.



VIEW OF SURFACE PLANT AND STAMP MILLS AT YELLOW ASTER MINE

Randsburg is situated in a small valley in the northeast end of Rand Mountains at an elevation of 3523 ft. above sea level, on the eastern edge of Kern County, 75 mi. east of Bakersfield and about 100 mi. northeast of Los Angeles. The Yellow Aster mine is situated about half a mile south of Randsburg at 500 ft. higher elevation. The Santa Fe railroad from Kramer, 30 mi. to the south, built in 1897, has a terminus at Johannesburg, one mile east of Randsburg and the Southern Pacific Owenyo branch from Mojave, 40 mi. to the southwest, built in 1909, passes Randsburg five miles to the northwest.

The story of the Yellow Aster is like a romance of the desert, woven around the wisdom and patience of a woman and the labor and hardships of three men. In 1893 Dr. Rose L. Burcham, of Los Angeles, returned to the practice of medicine to earn the money to grubstake her husband, C. A. Burcham, and John Singleton and F. M. Mooers. She agreed to furnish provisions for two years and to receive her share of the result of the venture. In April, 1895, the three men were camped at Summit Diggings at the head of a small valley, or wash, on the southern edge of Summit Range and 8 mi. northeast of the present site of the Yellow Aster.

Dry washing was in progress at Summit and at Goler Wash, about 8 mi. west, at the southern edge of El Paso

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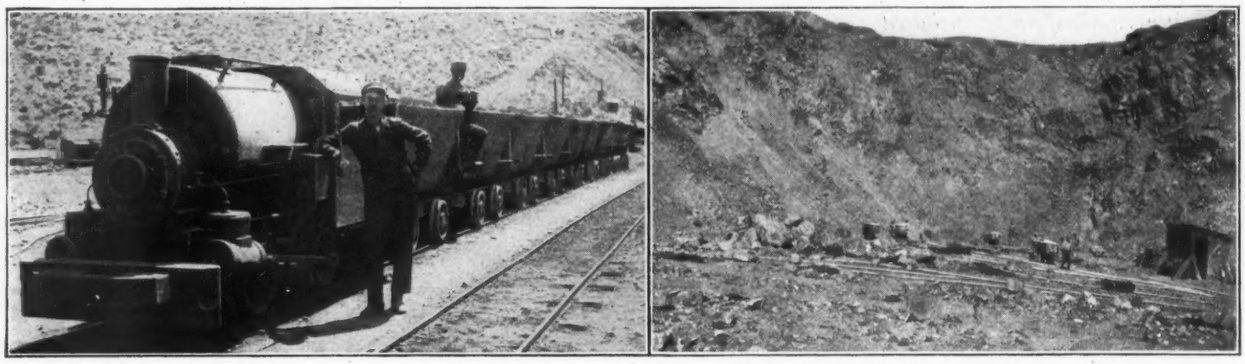
Mountains, where gold had been discovered in the winter of 1893-4. Other dry-washing camps sprung up at Red Rock Cañon and Lost Chance Cañon. Having only six months' grubstake left and believing they could fare no worse than they had, the three prospectors broke camp and moved over across the valley to a small gulch between two low peaks of the Rand Mountains. The first object that attracted their attention was a large slab of granite intruded in the schist, which resembled a tombstone. Singleton struck the rock a vigorous and vicious blow with a pick, determined to destroy any suggestion that this was their finish. The broken fragments of granite disclosed free gold, the first indication of success that they had met with in 18 months. All about them were similar slabs and masses of granite, all carrying gold.

The initial monument of the first claim staked was built on Discovery Rock and named Rand; it marked the point where they began active work. This has since been reduced to a glory hole. Singleton was at the time reading the story of "The Yellow Aster", so that name was given to the mine. They horned, panned, ground and retorted until they had enough gold to send Burcham to Mojave, then the nearest railroad and telegraph station, where he purchased tools and grub, recorded the claims and wired his wife that they had made a strike. Dr. Burcham made her first visit to the camp in the following July, when there were but two tents on the ground. Summit, Goler and other camps were practically deserted immediately following the find in Rand Mountains. Within a few months the little basin for a mile north of Discovery Rock began to assume the appearance of a real mining camp, and in 1896 Randsburg grew into a town of importance and later became famous as the home of the Yellow Aster and the mining center of that region.

In this early operation of the Yellow Aster, the ore was crushed in hand mortars and the gold recovered in a baby retort that held only about $150. The process was slow and laborious. No water for mining purposes was available, and water for drinking and cooking uses had to be hauled several miles. At nearly 4000 ft. elevation, they were in the middle of a great desert region where the summers were hot and the winters windy and cold. The men grew discontented, dissatisfied and discouraged. They were about to sell out for a few thousand dollars when Dr. Burcham, with much foresight and wisdom, persuaded them to sign an agreement to stay on the job and work together for five years. Before the period of agreement had elapsed they had installed a 30-stamp mill and were growing rich. In all this time that the men labored with their hands at the mine, Dr. Burcham made regular monthly visits, traveling from Mojave through the desert by team and buckboard and returned, usually at night, with the cleanup to take the train at Mojave for Los Angeles. The first shipment of milling ore went to Selby in September, 1895.

The Yellow Aster Mining and Milling Co. was incorporated in 1897 with the three discoverers, Dr. Burcham and John M. Miller as directors, who elected John Singleton, president, and F. M. Mooers, vice-president. Dr. Burcham was elected secretary and has held the position continuously since. As soon as the production of the mine warranted, she gave up the practice of medicine and devoted her time to the duties of secretary and the study of mining and mining law. She still continues her regular visits to Randsburg. Her knowledge of mining and studies in law saved the Yellow Aster from financial disaster and legal disruption. The first mill, of 30 stamps, was installed in 1899. The 100-stamp mill was installed in 1901. The first water plant, at Mountain Wells, was completed in December, 1898, and supplied water by pipe line 5 mi. long to the 30-stamp mill. In 1900 the Goler Wells plant was completed and water was piped 6 mi. to the 100-stamp mill.



LOCOMOTIVE AND ORE CARS AND VIEW OF GLORYHOLE WHERE THEY ARE USED

The Yellow Aster rock ranges from 20c. to $100 per ton, the entire granite body carrying free gold. The ore, as broken down by machine drilling, blasting and barring, runs from 75c. to $2.50 a ton, but by careful hand-sorting the average of ore sent to the mill is about $3.50. Estimating the grade of the ore is done entirely by shift bosses, by panning. The shift-boss average for the year 1915 were within 7% of the actual mill recovery. In the early stages of exploration three types of ore were disclosed: (1) Deposits along faults in crushed schist and granite, (2) stockworks in granite, (3) veins carrying varying amounts of quartz.

For the first 10 yr. all the ore was extracted by stull-stoping the narrow high-grade streaks and square-setting the wider and lower-grade orebodies. Until 1903 all mining was done by hand, but since then air drills have been used.

As the work advanced, a large body of low-grade ore was opened up, which could be more economically worked by the glory-hole system, and by 1910 nearly all the ore going to the mill came from the glory hole. Parts of this body of ore were covered with a schist overburden, in places 75 ft. thick. This was removed through mill holes run from the Rand level to the surface which was about 200 ft. above.

After starting the 100-stamp mill, mules and one-ton cars were replaced by a gasoline locomotive and 3-ton side-dump cars. This equipment was later replaced by oil-burning locomotives and 3-ton V-bottomed cars.

The main shaft was sunk to a vertical distance of 236 ft. below the Rand level, or 536 ft. below the top of the hill. After abandoning underground mining and getting all the ore from the glory hole, the bottom of the glory hole finally became too low to get the ore into the cars on the Rand level. Drifts were then run on the sublevel 80 ft. below the Rand, connecting with raises from the glory hole and the main shaft. Two-ton skips were put into the main shaft and the ore and waste hoisted to a bin above the Rand level. The trains were loaded at this bin and run to the crusher or to the waste dump.

The highest bench in the glory hole is about 200 ft. above the Rand level, and the lowest bench is on the sublevel 80 ft. below the Rand. The main floor of the glory hole is 40 ft. above the Rand. The headframe of the main shaft is on this level. All the ore broken, whether in the glory hole or in the underground workings, is sorted by hand, and rock that averages less than $1 a ton in place may be sorted to average $2.50 or more when it reaches the mill. During the last two years some of the better bodies in the underground workings have been reopened and are being mined. At the main shaft the ore is hoisted on day shift and the waste on night shift. One shift is worked in the outside workings and three shifts in the underground workings.

In the first 2½ yr. of milling 30 stamps were dropping continuously and in the following 12 yr. a total of 130 stamps. Since 1913 the 30-stamp mill has been out of commission, having run for 15 yr. The 100-stamp mill has been in continuous operation for 15 yr. and is still running, having a total capacity of 450 tons in 24 hr. This amount is equal to the tonnage that can be economically broken down and handled in one glory hole. The stamps weigh 1050 lb. each, the duty per stamp is 4½ tons in 24 hr. The ore is treated by stamping and amalgamation inside and outside, with no chuck plates inside. Experiments showed that the mill was not making as high percentage recovery as was possible by straight amalgamation, so the plating surface was practically doubled in the early part of 1916. This was done by first installing below the regular plates six sets of plates from the old 30-stamp mill. It was found that the recovery was sufficiently increased to warrant additional plates for the entire mill. The full plating surface is now 2940 sq.ft. The value of amalgam from the lower plates is $3.65 per oz. The value of amalgam from the entire mill is approximately $7 per oz. The tailings from the mill go to Dorr dewatering tanks, and the clear water is pumped back to the mill reservoir. Careful sampling has shown a loss of 50c. per ton in the tailings. Experiments looking to further recovery have been made. Little Wonder stamp-stem guides, invented at Yellow Aster, are used in the mill; two of them have been used for three years and are still doing duty, good as new.

For the first 15 yr. the mills were driven by steam, oil fuel being used. In the first half of 1914 complete substitution of electric power was made without interrupting the steam-power plant, which is held in reserve and a bypass system arranged at every pump station so that the change back to steam may be made without delay or trouble. The mill is driven by two 150-hp. Westinghouse motors, one for each battery of 50 stamps. The present electric equipment is the same as initially installed except for change in position of the motors.

Electric current is furnished by the Southern Sierras Power Co. from the substation at the east end of Randsburg, which is one of several substations along the power line between Bishop Creek generating plant in Inyo County and San Bernardino steam-generating plant, a distance of 241 mi. During the period when steam power was used fuel oil was shipped in tank cars to Johannesburg station and hauled by teams to the pump stations and the mill. There is now little demand for fuel oil for mining and milling purposes as the mines are economically supplied with electric power.

The company developed the only wells available for both mining and domestic water supply within the Randsburg quadrangle. This, according to the United States Geological Survey, comprises an area extending 17 mi. north and south and 14 mi. east and west and is part of the Mojave Desert. The Mountain wells furnished the first water for milling and domestic use. The Old wells, situated 4 mi. east of Randsburg, were brought in later for domestic supply. There are two wells at this point, one 1700 ft. deep and one 400 ft. deep. The latter furnishes sufficient domestic water, which is pumped into the town of Randsburg by a triplex pump. The two wells at Goler, 6 mi. northwest of Randsburg, supply water for the Yellow Aster mill. One is 1800 ft. deep and one 525 ft. deep. The water rises in both Goler wells to within about 60 ft. of the bottom of the mine shaft at the 455-ft. level. The water is pumped by deep-well pumps to the tank in the bottom of the mine shaft and from this tank is pumped to the surface by an electrically driven triplex pump. The water is pumped by duplex pump to the repump station at Randsburg, and from the repump station it is pumped by a 700-gal. turbine to the mill reservoir. Both the Goler and repump stations have auxiliary steam equipment.

Other mills in the Randsburg district were for many years supplied with water by tank cars on the Santa Fe railroad, and until about two years ago there was no local supply direct for milling purposes, though the Randsburg Water Co. furnishes some mill water. The Wedge shaft of the Consolidated Mines Co. began furnishing water about three years ago and is now supplying 1,000,000 gal. a month.

The safety of miners and other workmen has always been a care of the management of the Yellow Aster. In the last nine years there have been only three fatal accidents in the mine. As result of further improvement with the assistance of the mine-safety department of the State Industrial Accident Commission there have been only two total permanent disabilities, both men being blasted, since the compensation law became effective. The mine is provided with two sets of mine-rescue apparatus, pumps, oxygen tanks, meters, etc., and the mine-rescue and first-aid teams are given regular training. As a result of efficient precautionary methods the company carries its own insurance at less than half the state insurance rate and is competent to handle serious surgical cases in its own hospital, in charge of a surgeon and trained nurse, which is a large factor in the reduction of the insurance rate and cost of treating the injured.

Dr. Burcham is the only survivor of the four original owners of the Yellow Aster. The three discoverers of

the mine and founders of Randsburg and the Randsburg mining district lived to enjoy the results of their labor and count themselves among the rich men of southern California. Until their decease Mr. Singleton continued as manager and Mr. Burcham as superintendent. They were both indefatigable workers from the day they found gold in Discovery Rock, and prior to the prospecting trip that ended with the discovery and was followed by the development of the Yellow Aster, they were both practical and experienced miners. E. D. Mooers succeeded to his father's interest. Mrs. Burcham retains her own and her husband's interest, and Mr. Singleton bequeathed practically his entire fortune to his wife and daughter. The personnel of the Yellow Aster Mining and Milling Co. has undergone several changes. The present directorate is composed of Albert Anker, president; Arthur Asher, vice-president; W. J. Cotton, managing director; Dr. Rose L. Burcham, secretary; Ward Chapman, attorney; National Bank of California, treasurer. Carl H. Fry, who for six years was mine foreman under Singleton and Burcham, became superintendent upon the death of Singleton. At the same time J. H. Farrel, of Los Angeles, was appointed consulting engineer. They immediately mapped out a line of work, both development and exploration on the property, which has been carried out by both these men, and mainly to their devotion and loyalty Dr. Burcham attributes the success of the mine during the last 2½ years.

Portable Railroad to Atbasar Mine in Siberia

The transporting of 3000 tons of heavy machinery for the new smelting works of the Atbasar mines, of the Spassky Copper Co. in Siberia, by means of a portable railroad, was discussed briefly in the *Engineering and Mining Journal* of Dec. 9, 1916. Some further information in regard to this operation has been obtained from E. T. McCarthy, the consulting engineer of the company. The distance from the Trans-Siberian Ry. depot to the site of the smelting works is about 240 mi. The method of procedure was to lay about 10 mi. of track, using a 35-lb. rail. Over this distance the equipment was transported in trucks, together with two 42-ton locomotives and two small ones, which, owing to the badness of the water en route, were not used, a second-hand locomotive being employed for this transport. As soon as the cars and locomotives arrived at the far end of the track, the rails were picked up and carried to the front, where another 9 mi. of track were laid down, and so on.

The main difficulties were those connected with the climate and with the war. There are only about six months in the year in which climatic conditions make work possible, and because of the war, mobilization and some local trouble with the Khirgese labor, the time required for the transport was much increased over what might have been the case in normal times. The train with its load of smelting equipment and the locomotives arrived last July within 40 mi. of the smeltery site, when a local outbreak among the Khirgese tribesmen took away the labor again, and the train was "parked" until the coming spring.

The transport has been successfully carried out, with the exceptions of the interruptions mentioned. It may be wondered why ordinary wagon transport was not adopted. The company had found by previous experience that a load of more than three tons could not be successfully transported over the desert in wagons. What appears to be a hard surface and a seemingly good road is only a thin crust, through which the wheels sink if the wagon be overloaded. Even if the road were good, the camels in this region are not taught to pull together and there would have been considerable trouble in training them to do so. The minor difficulties were mainly in providing camps and food for the Khirgese and in supplying water to the locomotive in this desert country. Wells were sunk at spots discovered by the company's prospectors, and the water was conveyed by motor trucks to the tanks provided on the train.

Geological Survey Engineers in the Engineer Officers Reserve Corps

Secretary Lane has approved the applications of 93 topographic engineers in the United States Geological Survey for commissions in the Engineers Officers' Reserve Corps of the Army. This corps is established in conformity with the general plan, now being rapidly worked out by the War Department, to organize and have promptly available for active service in time of need a large number of specially qualified men. The topographic surveys and maps made by the Geological Survey are recognized as war necessities, and the Survey is now carrying on special field work in coöperation with the Engineer Corps of the Army to produce military maps. The total number of applications for army commissions thus far submitted amounts to 80% of the topographic field force of the Survey.

Interpretation of Contracts

By Arthur L. H. Street*

In an action to recover money claimed to be due under a contract for sale of mining claims, the Utah Supreme Court decides that where such a contract is unambiguous in its terms and there is no showing that either party was induced to enter into it through fraud or oppression or that the terms of the agreement are violative of law or public policy, courts are powerless to place a forced construction upon the agreement in order to make it conform to the judicial idea of equity and fairness. (Johnson vs. Geddes, 161 Pacific Reporter, 910.)

The court also applies the well settled rule governing contracts in general, that the plains terms of an agreement cannot be enlarged or contradicted by evidence of verbal negotiations preceding or contemporaneous with the execution of the written contract.

Consumption of Aluminum in 1916

The domestic consumption of aluminum in 1916, according to estimates of the United States Geological Survey, was over 121,000,000 lb. The estimates are based on statistics of the domestic production for the year and of the imports for 9 months. This is an increase of more than 21% over the consumption of 1915. These estimates do not include the consumption of secondary aluminum obtained from scrap materials, which is believed to have also increased.

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Mining Conditions at Potosi, Bolivia

By Benjamin L. Miller* and Joseph T. Singewald, Jr.†

SYNOPSIS—Potosi, Bolivia, is probably the world's greatest silver producer—it has a record of at least 1,000,000,000 oz. mined in the last 372 years. Mining will continue profitable for years to come, yet as the district is dominated by three strong operating companies owing to the district's peculiar mining laws, there is no opportunity for new companies to obtain a foothold. Details of mining, chloridizing, roasting and lixiviation are given.

The history of old mining districts is fascinating and instructive, yet disappointing, as seldom can one obtain enough information to form an adequate conception of the various stages through which the region has passed. Throughout Latin America are thousands of abandoned mines, *antiguas*, concerning which little information can be obtained, yet often credited, by shrewd promoters, with practically unlimited hidden riches.

While many of these *antiguas* have been revived and have paid handsome dividends, in some cases it has been found, after rehabilitation, that the old Spaniards with slave labor had removed all the rich ore and, at times, even low-grade ore that could not now be worked with profit, in spite of improved methods of ore extraction and concentration, because of the present higher cost of labor.

In comparison with other old mining camps of South America, Potosi forms a striking exception. From the discovery of silver in Potosi Mountain, *Cerro Rico de Potosi*, in 1544 to the present, mining seems to have been carried on continuously, and still the mines yield sufficient wealth each year to make the continuation of mining in the region most profitable. After 372 years of work the end is not yet in sight, and it may well be predicted that these mines will equal the longevity record of the recently closed mines of Freiberg, Saxony.

History of the Potosi Region

There are several versions of the story of the discovery of the orebodies of Potosi, but the one most generally accepted is to the effect that an Indian miner, delayed by a llama straying far up the side of Potosi Mountain, camped out on it over night. The following morning he discovered that some of the rocks had been melted by the heat of his camp-fire and appeared spotted with bright metallic globules later pronounced silver by his Spanish master.

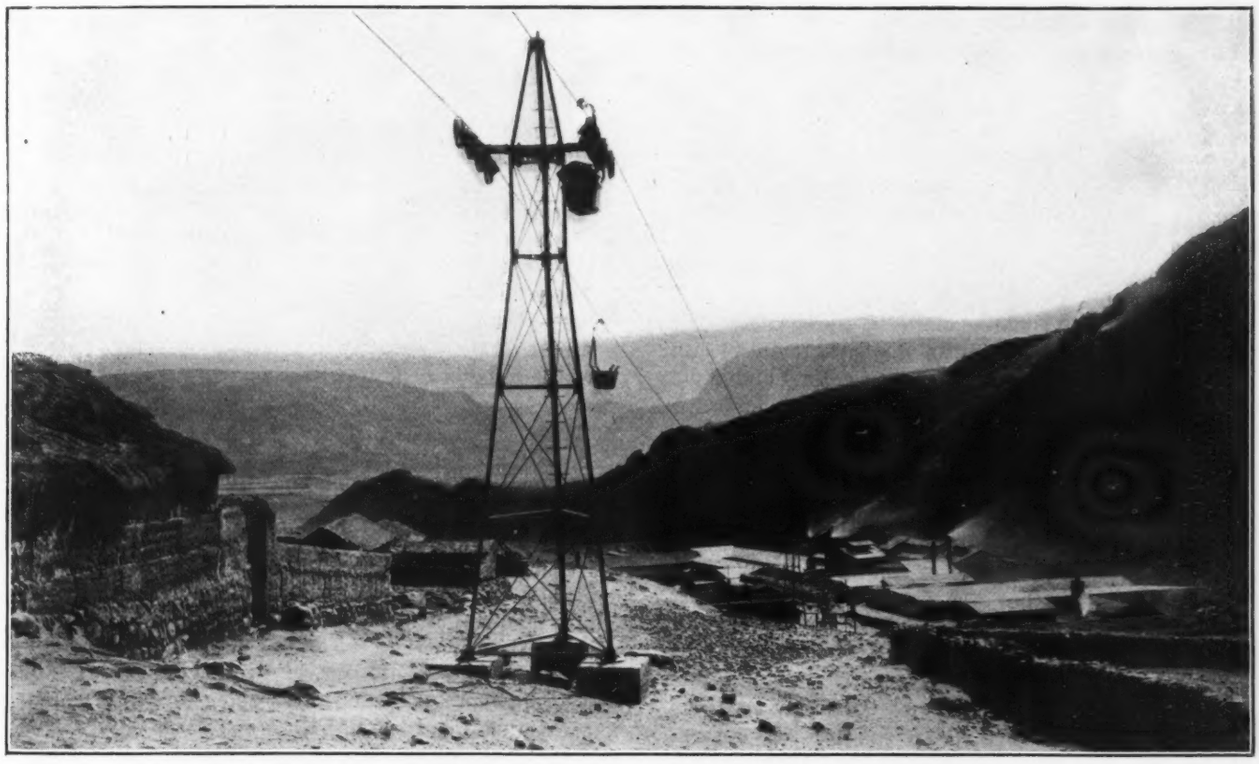

FIG. 1. VELARDE MILL OF LUIS SOUX, POTOSI DISTRICT, BOLIVIA

Active mining began, and the following year the present town of Potosi was founded. From the first the ores encountered were unusually rich, and in a few years the City of Potosi increased in population to 160,000, according to the records, although the present city numbers only about 20,000 inhabitants. For more than a century this Andean city was the metropolis of the Western Hemisphere and many stories still survive of the lavish display of easily acquired wealth during this period.

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†Associate in economic geology, Johns Hopkins University, Baltimore, Md.

After the South American countries had gained their independence, English capital was attracted, and in 1825 numerous companies were formed in London to operate mines in Potosi. The days of the "Mississippi Bubble" and the rubber speculation of a few years ago were anticipated, and wildcat companies profited as usual. Legitimate mining survived, however, and during the Nineteenth Century the mines of Potosi produced a few hundred thousand ounces of silver annually.

Between 1890 and 1900 the tin ores first received serious attention, although known to exist long before, and the declining mining industry was revived. Since then mining has been active and large profits have been made by the leading companies which mine and treat both the silver and tin ores. Although the tin contents have proved to be more valuable than the silver, the silver production is considerable, while some copper is also obtained.

Silver Production Exceeds 1,000,000,000 Oz.

Various figures have been given of the total production of silver from the Potosi mines, but so widely do they vary that one cannot place much reliance upon them. While the record of production during the days of Spanish rule was supposed to be kept accurately because of the taxes levied by the Crown, it is fairly certain that even then much of it was never reported. By some the total value of the silver produced is estimated at over $3,000,000,000; by others much more than that. The total production of silver probably considerably exceeds 1,000,000,000 oz., and may even be more than twice that amount, as other investigators claim. At any rate the mountain holds the world's record for its silver production, and probably no other mining region of equal area has ever produced an equal amount of wealth.

Potosi Mountain, appearing in the background of Fig. 3, has an elevation of 15,381 ft. above sea-level and is one of the peaks of the eastern range of the Andes, known as the Cordillera Real, that bounds on the east the great interior plateau of Bolivia. It is one of the most beautiful and most symmetrical conical mountains of the Andes. In Bolivia it occupies much the same place that the volcanic cone of Fujiyama does in Japan and is represented in the country's coat of arms and on many of the coins. The mountain, however, is not a volcano, although some of the rocks forming it must have been thrown out of near-by volcanoes.

Although within the tropics, the entire upland region of Bolivia is cold because of the great elevation. A prominent Bolivian states that the region has two seasons, spring and winter. The spring is the time when the main precipitation occurs, much of which falls as snow, while the remainder of the year is dry and cold. The annual precipitation, according to the prefect of Potosi, is about 20 in. The low temperature and light rainfall are responsible for the treeless character of the region, and the visitor to the old mint marvels at the efforts and expense that must have been put forth to bring from the distant eastern slopes of the mountains the massive timbers used in the construction of this interesting and historic old building.

During the most flourishing days the region was remote from main lines of transportation and reached only by long and difficult trips on muleback from Buenos Aires or some of the distant Pacific ports. Not until May 15, 1912, was it connected by railroad, and even now there is little contact with the outside world. There is but one passenger train each way a week, coming from Rio Mulato on the main line of the Antofagasta-La Paz line each Saturday and returning the following Tuesday. The branch line is 108 mi. in length and reaches an elevation of 15,814 ft. above sea-level. The train does not attempt to break any speed records, for it takes nine hours to make the trip, or an average of 12 mi. per hr. The railroad has done much to revive the mining industry of Potosi, however, as well as of other districts along the route.

Potosi Mountain, as shown in Fig. 4, consists of a central core of porphyritic rhyolite (grading in places into dacite or even andesite) surrounded by conglomerates, shales and tuffs that in most places dip away from the central mass. The conglomerates contain large boulders of rhyolite of somewhat different character than the rock forming the core of the mountain and also blocks of shales. The tuffs on the northeast slope of the mountain and also in some of the tunnels carry plant remains. Earlier collections of these fossil plants were studied by Britton and Engelhard, who pronounced them of Tertiary age, while Edward W. Berry is studying the collection which we made. He states that "the fossil flora contain about 50 species and is very similar to that occurring at the present time on the slopes of the eastern Andes at considerably lower levels. Its resemblance to this recent flora leads me to consider it late Tertiary, probably Pliocene, although it may be Pleistocene." A brachiopod obtained near the base of the mountain has been determined by Prof. C. Schuchert as a new species of Discinisca closely allied to existing species of the west coast of South America and certainly not older than the Tertiary. This evidence is extremely interesting and also startling, as it indicates the very recent uplift of the high Andes from beneath the waters of the Pacific Ocean and the extremely recent age of the mineral deposits of the region.

Vein Systems and Orebodies

The ores are found in fairly well-defined fissure veins with a small amount of replacement of the country rock. The main veins have received names, but when one goes through the mines with different superintendents on successive days, he soon realizes that the nomenclature adopted is not very definite. All the miners recognize certain names, but differ in their application of these names to the various veins. Also, numerous other veins are unnamed or else are called *ramos* (branches) of the named vein that is nearest. The whole mountain is cut, as shown in Fig. 5, by hundreds of approximately parallel veins that have an average strike of about N 10° E and a dip of 80° or greater to the southeast in most places, but in some instances to the northwest. The rock between the veins is considerably mineralized, and one company a few years ago sampled the mountain very thoroughly to determine whether it might not be possible to work the entire mountain as ore by means of steam shovels. The veins vary in width from a few inches to 12 ft., although where we observed the latter thickness in the Tajo Polo, it was really a series of small veins in shattered rock and not a single fissure vein. In many cases the vein materials in the sulphide zone show distinct banding of pyrite and tetrahedrite.

There are fewer veins in the shales than in the rhyolite, but along the bedding planes one frequently observes thin

layers of pyrite, and probably there is likewise some tetrahedrite and cassiterite. In the shales the ore has formed mainly in shattered zones, while the veins in the porphyry are more nearly true fissure fillings. In proximity to the veins both sedimentary and igneous rocks have undergone much alteration. Both kinds of rocks have been silicified, the feldspars have been thoroughly kaolinized in places, and cubes of pyrite are abundant.

The ores of the mountain consist of two classes, the upper oxidized ores (*pacos*) and the lower sulphide ores. The depth of oxidation is not at all regular, and in some places where drifting has been done along a vein, the ore repeatedly changes at the same level between these two classes. The porosity of the ore largely determines the depth of oxidation, and much sulphide ore is found far above water level where the veins are unusually compact. No oxidized ores have been encountered in the Real Socavon, which is 2,050 ft. below the top of the mountain.

Almost all the veins carry both silver and tin minerals as well as a small amount of copper and a still smaller quantity of gold. In the oxidized zone the silver occurs as horn silver (cerargyrite) and native silver, while in the sulphide zone the upper portion is characterized by an abundance of ruby silver (pyrargyrite) and at lower levels by tetrahedrite. The tin occurs as light-yellow cassiterite; in most cases in compact laminæ, but in places as tiny crystals lining vugs. Pyrite is practically the only gangue material present, although small amounts of barite and quartz were observed.

Due to the removal of the pyrite, the oxidized ores are porous and highly stained with limonite; while the sulphide ores are compact. The walls of the old drifts and stopes in the sulphide zone are coated with incrustations of iron sulphate, much of which forms bunches of white, satiny fibers several inches in length, resembling asbestos.

The tenor of the ores is extremely variable. In places there are bonanza oreshoots extremely rich in silver or tin, or both, while elsewhere the veins may be too lean to stope. Some veins, such as the Estaño, are characterized by their high tin content; while others, such as the Rica, are noted for the rich silver ores. At the mouths of the tunnels, such as that shown in Fig. 2, the ore is sorted by *Cholo* women, who discard from 10% to 50% of the material mined. One company states that the ore that they send to the mill averages from 20 to 25 oz. of silver and 8% to 10% tin. At the Velarde mill of Luis Soux, shown in Fig. 1, the oxidized ore after hand-sorting contains 3% to 4% tin, while the sulphide ore contains about 15% tin and 3% copper, with varying amounts of silver. About five years ago a careful sampling of the principal working mines showed an average of 8% tin and 30 oz. silver to the ton. This included both oxidized and sulphide ores.

The richest silver ores have been found in the upper part of the zone of sulphides, where ruby silver predominates and indicates a considerable amount of secondary enrichment by meteoric waters. The vast amount of mining done by the Spaniards in the oxidized zone, however, extending to the very top of the mountain, shows that much silver ore, altered to horn silver or native silver, remained in the upper levels. At the present time the oxidized ores mined furnish only small amounts of silver. The percentage of tin averages about the same in the two classes of ore.

Primitive Mining Conducted for 372 Years

The mining in Potosi is primitive and is carried on with little system, owing to the unintelligent *Cholo* miners and also on account of the thousands of tunnels, drifts, stopes and winzes that honeycomb the mountain. It is said that 5,000 mines have been worked in the mountain, operations extending over 372 years. Therefore one can readily appreciate why the present companies are working in a small way in numerous places, mining the tin ore which the Spaniards entirely disregarded, as well as bunches of silver ore that were overlooked. It is an interesting experience to go through the mountain, although not altogether pleasant on account of the narrow, ancient connecting drifts. Should one lose his way, he might wander about for days through a labyrinth of drifts before reaching the surface.

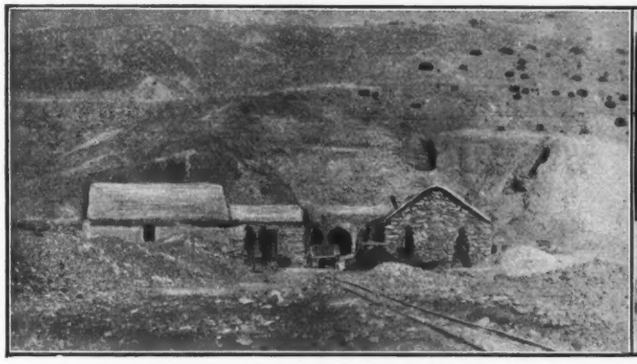

FIG. 2. TYPICAL MINE TUNNEL, POTOSI

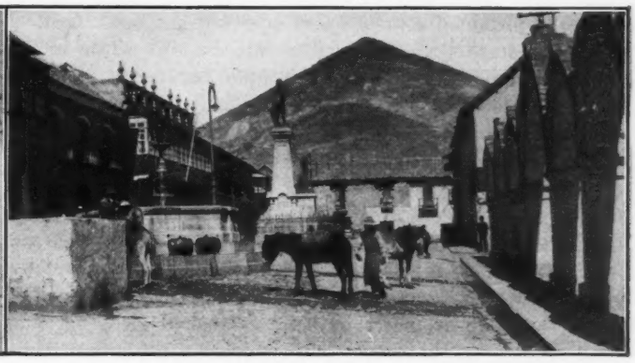

FIG. 3. CITY OF POTOSI, WITH MOUNTAIN IN THE BACKGROUND

All mining is done through tunnels, most of which enter from the north side and run south, with numerous crosscuts to the different veins. Drifts and stopes are driven where the ore values are sufficiently high. Practically no timber is used in the mines and very little rock-filling is done, although some stone walls and arches have been constructed. There are numerous stairways connecting different levels, and considerable ore is carried in rawhide bags up and down these passages to the cars, which are trammed by hand.

In Potosi the old Spanish mining law, which now applies to only two Bolivian mining districts, still persists. Under this law any person, on the payment of a small sum, can obtain a permit to start a tunnel into the mountain at any point not already appropriated. Through this tunnel work can be extended to any part of the mountain as long as there is no interference with the work of other companies. If one company breaks into the work-

ings of another, work must be stopped and a stone wall constructed. No company can obtain any reserve orebody, and all ore belongs to the first party to reach it. The law was framed to aid the poor miner by supposedly giving him an equal chance with the large operator; but, in its present application, the largest companies have practically a monopoly and no new companies could hope to get much ore.

Attempts were made a few years ago to drive a long tunnel near the base of the mountain to cut the orebodies at a lower level than they have yet been worked. The project was abandoned, however, when it became apparent that one of the companies then operating was preparing to sink a shaft and cut the first orebody directly in front of the advancing tunnel. One of the present companies operating in the mountain is engaged in trying to reach and cut certain orebodies in advance of the company now working them. It can readily be seen that the most powerful company with the greatest network of tunnels and the ability to drive drifts most rapidly may eventually confine the other companies to very restricted areas.

An operator owns all openings that he makes and also the dumps on the surface, and both of these are bought and sold. Thus the purchaser of a mine does not buy a pound of ore in place, but only the openings in the mountain which may conduct him to places where ore can be obtained provided someone else does not get there first.

The *Cholos* do all the work of mining and, while inefficient, must nevertheless be relied upon because of no other supply of labor. An attempt was made at one time to work the mines by imported labor, but it was found that the men brought from lower-lying regions could not endure the high elevation and soon left. Most of the *Cholos* chew the coca leaf almost constantly, though they do not seem to suffer ill effects from the cocaine which the leaf contains as much as do white men who acquire the habit. By preference the *Cholo* miner will remain in the mine for a 36-hr. shift without eating or sleeping, but with a good supply of coca leaf, which he can obtain from the mining company at the mouth of the mine. The numerous feast days interfere greatly with the work, for not only does the *Cholo* spend those days in dancing and drinking, but also the succeeding days as well. A holiday thus means almost complete cessation of mining work for several days.

The *Cholos* are very superstitious and have many queer beliefs. One of these in connection with the Whitsunday observances is typical. On that day the miners will kill one or two sheep or llamas at each tunnel and sprinkle the blood about the entrance, claiming that the mountain is hungry and must be fed, else it will cease to be productive. The mine owners usually furnish the animals, but should they fail to do so, the *Cholos* will provide them.

Chloridizing, Roasting and Lixiviation

In almost every case the ore as it comes to the surface is dumped in piles, where *Cholo* women break it and remove the barren rock. It is then taken down the mountain for further concentration. The company of Luis Soux has an aërial tram by which the ore is transported to the mill, shown in Fig. 1, situated in the valley below the town of Potosi, while Bebin Hermanos send the ore from their mines to the mill by burros. Llamas are used much less in Potosi than in other mining districts of Bolivia.

The treatment of the sulphide ore is most elaborate, as it contains silver, copper and tin. A generalized description of the mill of the Royal Silver Mines Co., Ltd., is given here.

The ore as it comes from the mines is sized and the coarsest material, exceeding 1-in. diameter, partially roasted in a series of 20 small furnaces holding about 5 tons each. This preliminary roasting is primarily for the purpose of facilitating the crushing of the ore, which is accomplished by rolls. The material is reduced to 1 mm. in size, the oversize being returned to the rolls after passing over trommels. The ore then goes to ovens where it is thoroughly roasted. The fuel used is either *taquia*, the dung of the llama, or *yareta*, a moss-like highly resinous plant that grows at high elevations. *Taquia* is preferred and more generally used, as the *yareta* is now rather scarce. The cost for either is about the same—from $4 to $4.50 a ton. The fresh ore is roasted eight hours, while the partially roasted material only requires six hours. About 7% of salt is added during the last half-hour of the roasting.

The roasted ore is put into the lixiviation tanks, 19 in number, holding about 10 tons each, where fresh water is added to dissolve the copper. This solution is drawn

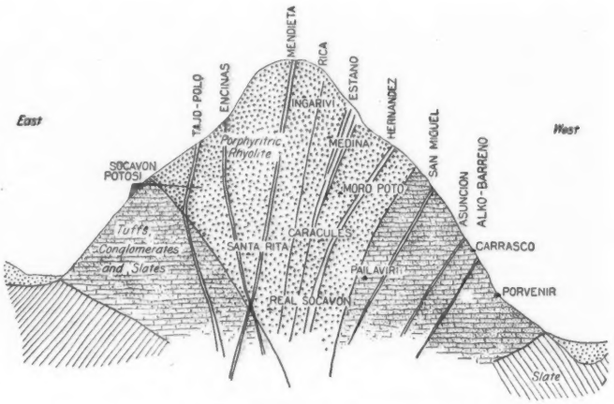

FIG. 4. IDEAL GEOLOGICAL SECTION OF POTOSI MOUNTAIN

off after three days into long, narrow troughs where old iron is placed to precipitate the copper. The ore is then treated with a solution of hyposulphite of soda which is allowed to remain 12 days; then it is withdrawn and calcium sulphide added to precipitate the silver. The CaS_2 is made at the plant by mixing sulphur (obtained near-by) and lime and passing steam through the mixture. The precipitated silver sulphide is shoveled into sacks and pressed in a hand press and then roasted in a furnace to eliminate the lead, antimony and excess of sulphur. The product, which contains from 40% to 45% Ag, 8% to 10% Cu and about 4 oz. of gold to the ton, is shipped to Liverpool.

The residue from the lixiviation tanks and also the oxidized ore now mined, in which there is little silver, are treated on tables and jigs, where the bulk of the tin is recovered. The concentrates from the tables average about 55% tin and after treatment in kieves produce *barrilla* for shipment containing 60% tin. The jigs also produce *barrilla* for export, while the tailings are reground and passed over tables. The tailings of the second series of

tables are reground by stamps or ball mills, classified by spitzkasten, and the coarsest sent to a jig, the next size to tables and the finest to slime tables. The concentrates from the slime tables go to two small stationary buddles, where the heads are treated in a kieve producing export *barrilla*. The tails from the other tables also go to buddles.

In all the mills the processes of ore-treatment are essentially the same, although naturally the arrangement of the tables, jigs and buddles may vary somewhat in the different establishments. At the Velarde Ingenio of Luis Soux, three different grades of concentrates are produced, containing +60% Sn, 30-60% Sn and less than 30% Sn. The first grade is exported, the second grade smelted at the establishment, and the third grade is re-treated. About 10 tons of concentrates are smelted daily in a small blast furnace, where charcoal is used, and the product is purified in a reverberatory furnace. The molten metal is further purified by being drawn off into a vat and pieces of cactus pushed down into the liquid tin by means of a

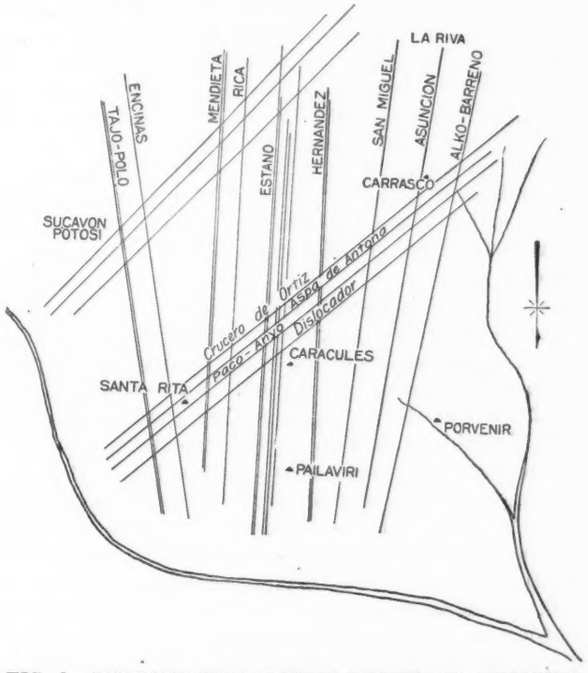

FIG. 5. SURFACE MAP, POTOSI MOUNTAIN, SHOWING VEIN OUTCROPS

stick. This causes intense boiling, and a scum of impurities collects on the surface, is skimmed off and returned to the furnace.

Luis Soux exports about 200 tons of tin *barrilla* monthly, of which the following is an average of a partial analysis: Sn, 62.55%; iron oxide, 14; SiO_2, 5; Cu, 0.10; Sb, 0.20%; and Ag, 2 oz. per ton. A complete analysis of the bar tin shipped is as follows: Sn, 94.060%; Sb, 2.277; As, 0.268; Pb, 2.445; Bi, 0.085; Cu, 0.387; Fe, 0.329; Ag, 0.061; S, 0.037; and O and loss, 0.05%; total, 99.999%. A partial analysis of a silver-sulphide shipment yielded 16,167 oz. silver, 4.625 oz. gold and 22.48% copper.

The greatest difficulty in the concentration of the ores is the scarcity of water. In the early part of the Seventeenth Century the Spaniards built a series of dams in the Kari-Kari range of mountains to the east of Potosi, producing a number of lakes. It is said that there were originally 32; but as they have been neglected, there are scarcely half that number now in service. The municipality controls the supply, and the mining companies are so limited that the mills along the small stream running through the city use the same water repeatedly. The greatest shortage of water is experienced during September and October, when the mills can run only part of the time.

Three Large Companies Control District

The largest operations are conducted by Luis Soux, a Frenchman, who has made a fortune during the past 20 years in his Potosi mines. His principal mines are the Caracoles, Moropoto, Medina, Poderosa, San Dimas, La Riva, Santa Rita, Pailaviri and Potosi, all of which, with the exception of the last, are on the north side of the mountain. The output of his mines during 1915 was about 16.5 tons of ore a day. He has several small mills and one large one, the Velarde (previously mentioned and shown in Fig. 1), which is just below the town of Potosi.

Bebin Hermanos, operating on the northwest side of the mountain, work the *pacos* ores alone, and consequently produce only tin. They also buy some ore from the small operators. Their principal mines are the Carrasco, Chingurani, San Antonio and Puytucani. They have two mills in Potosi—the Huayra and the Santa Rosa. Their production is extremely variable. For example, during May, 1915, they shipped 134 tons of 55+% tin *barrilla*, while in the following month they only shipped 41 tons.

The Royal Silver Mines, Ltd., operates on the northeast side of the mountain, its principal work being done through the Real Socavon. Since the outbreak of the European War this company has been doing very little mining; the mill, however, has been run most of the time on ore sorted from the rock-dump and old tailings. The tailings milled contain from 3% to 4% tin, and the ore sorted from the rock-dump by *Cholo* women contains from 7 to 11% tin and some silver.

In addition there are a few small workings being operated by individual operators, and some of the old dumps that cover almost the entire north slope of the mountain are being worked over. From all accounts the large companies are all prosperous and there is promise of continued successful operation for many years to come; but on account of the unique mining laws there is little opportunity for any new companies to gain a foothold.

Tin-Placer Workings Increase Output

Until about 20 years ago, no attention was given to the tin minerals in the Potosi region and the cassiterite-bearing residue from the silver mills was thrown into the streams as waste. The result has been the development of rich tin-placer deposits. Close to Potosi the stream gravels are from 6 to 15 ft. thick, and as the values are mainly confined to the lower layers, numerous drifts have been driven from the side of recent ravines. Farther down the stream, however, the gravels are seldom more than 5 ft. thick and the cassiterite sands at the base are reached by pits or ditches.

Matias de Mendieta has the principal placer concessions and has been engaged in the work for the past 19 years. Mendoza & Co. have placer concessions at a few places, while a French company was engaged in 1915 in building a small mill to treat the sands from a tract a few kilometers below Potosi.

The sands are dug by Indians, who are granted permission to work wherever they choose, but required to sell their product to the company owning the land. During 1915 the Indians received about 8 bolivianos ($2.40) a quintal (101.4 lb.) for concentrates containing 40% tin and 5 bolivianos for 30% tin concentrates.

The upper gravels are thrown to one side in the digging and the lower layers dug and thrown against a screen to remove the larger pebbles and cobbles. As almost all the cassiterite has been derived from the old silver establishments near Potosi and consequently is fine, only the finest sands are saved. The washing of the sands is done in small sloping troughs about 4x2 ft., usually made of stone blocks. By hand-washing methods the Indians produce concentrates running from 30% to 45% tin. The product finally delivered at the mills contains, besides cassiterite, considerable quantities of magnetite, hematite and garnet as impurities.

Typical Mining Practice at La Palca Ingenio

In the mills the material bought from the Indians is treated by jigs, tables and buddles. At La Palca Ingenio of Mendoza & Co., a mill typical of all those in the region, the product is first sized by means of a simple trommel. The coarsest size, containing about 40% tin, is not treated further; while the other two sizes go to jigs that make three products—*barrilla* for export containing about 62% tin; seconds containing 40% tin, which are sold to Luis Soux to be smelted or further concentrated at his mill near Potosi; and a third product, which is ground in ball mills and then passed over tables or treated in buddles. The tables produce concentrates containing about 35% tin, which are sold; and tailings averaging 12% tin, which are now being stored.

If the materials from the ball mills are treated in buddles they are washed several times and finally three products are obtained—*barrilla* for export, with 50% to 52% tin; seconds with 30% tin, which are sold to Luis Soux; and tailings containing 4% to 5% tin, which are thrown in the river. The company has a small magnetic separator run by hand which is used part of the time to remove the magnetite grains. The *barrilla* from the placers contains about 4% antimony and also a little silver.

As one goes down the Tarapaya River and sees the heaps of discarded gravels on the flood plains all the way to Miraflores, it is natural that the impression should be gained that the placer ground has all been worked over. The unsystematic manner in which the work has been carried on, however, furnishes reason for the belief that considerable quantities of ground still remain untouched. During periods of flood, the waste heaps (in which there are some values) are reconcentrated; so that certain areas may be reworked with profit. Nevertheless, the annual production of placer tin in the Potosi region is on the decrease, as is shown by the output of the two companies. Mendieta has in the past produced as much as 50 tons of *barrilla* monthly while now he seldom produces more than 30 tons. Mendoza & Co. formerly produced as much as 30 tons a month, while now their monthly output is less than 20 tons. In the past the profits in tin placer mining were large. The industry is still profitable, and it may remain so for a number of years to come, especially if the war demand continues to restrict tin shipments from the Orient.

The Gasoline Situation

In a recent address delivered before the Washington Retail Merchants' Association, Van H. Manning, director of the Bureau of Mines, pointed out the governing features in the gasoline situation. The consumption of gasoline is steadily increasing while the production of crude oil, the raw source of gasoline, is stationary or declining.

In 1915, when gasoline was as low as 11c. a gallon, the Cushing Field in Oklahoma was producing crude oil containing 25 to 30% gasoline at the rate of 300,000 bbl. per day. This production has declined to less than 60,000 bbl. per day. Automobiles, the chief users of gasoline, increased in number from 2¼ million on Jan. 1, 1916, to 3¼ million on Jan. 1, 1917, and it is estimated that 4½ million will be in use by 1918. These conditions (the reduction in supply and increase in requirements) are being met jointly by the automobile engineers and the refiners.

The former have improved their engines and carburetors, making it possible to use heavier fuels in the automobile of today, than would have been practical a year or two ago. The refiners, taking advantage of the work of the engineers, have been able to use heavier oils for gasoline, thereby increasing the percentage of gasoline obtainable from a given amount of crude oil. This has resulted in increasing the "end point" from 150° C. in 1915 to an end point of 175 to 200° C., the figure of today. The end point is the temperature at which 95% of the gasoline will distill off if handled in a proper flask at the proper rate.

The end point is important because it is a measure of the readiness of the gasoline to vaporize, information which it is desirable and necessary to have in selecting suitable fuel for gasoline engines. As a result, the refiners have been able to supply a lower-grade fuel, which is now adaptable to the improved automobile engine.

Refiners are coöperating along another line to the same end; namely, to increase the amount of gasoline and at the same time to keep the price down to a reasonable basis by means of "cracking" kerosenes and heavier oils, thereby converting into gasoline a certain proportion of the crude oil that formerly was not utilized for that purpose. In 1915 there was produced by the cracking process approximately 2,000,000 bbl. of gasoline; in 1916 it is estimated that more than 5,000,000 bbl. was produced in this way. This is all the more striking when it is considered that this gasoline was made from oils which, in the past, did not enter into the making of this product, and it also indicates the possibilities of the present production of crude oil to supply the future requirements of the automobile.

Recently, owing to the remarkable development of the casing-head gasoline industry—that is, the obtaining of gasoline from natural gas—there has been obtained a product called blended gasoline. The casing-head gasoline is too volatile to be used directly. It is therefore mixed with oil just a litle lighter than kerosene, but heavier than gasoline. Such a blended gasoline may be of any gravity desired by the manufacturer, but it is naturally different in composition and properties from the straight refinery product which it may chance to resemble in gravity only. This is due to the fact that it is generally composed of more of both the heavier and lighter oils than gasoline made by the ordinary processes.

Zinc-Box Work

By H. T. Durant*

In the early days of cyanide work the solutions entering the zinc boxes were strong in cyanide, in comparison with later and modern practice. The difficulties experienced were much more frequent and owing to the different working conditions, were somewhat different from those that now occur. In general the following will refer only to the use of zinc shavings, but in places it will be obvious that it could equally well refer to zinc dust.

There is much literature dealing with every phase of zinc-box work, but that which has for its basis laboratory experimental work is not always of value, as it is almost impossible in small-scale zinc-box work to obtain true works conditions.

Causes of Zinc-Box Troubles

The troubles in the boxes, of which one used to hear and see so much, were principally one or more of the following: White precipitate on the zinc, so-called zinc ferrocyanide; gelatinous silica forming in the boxes; hydrated alumina coming out in the boxes; coffee-colored solutions, which it was almost impossible to test owing to their color; muddy or slimy solutions; a very general complaint, which used to be generalized as "foul solutions."

One or more of these troubles at times was likely to make the life of the cyanide engineer a burden, when boxes ceased to work properly almost at once and solutions began to leave at the same values as when they entered, or even at higher values. In despair various procedures, often more heroic than wise, were adopted, which were not usually too openly discussed.

Before considering in detail the causes of these various troubles, it is as well to recall that when cyanide solution containing gold, etc., acts on zinc, certain reactions take place, and one of these is that zinc compounds are formed, which, if enough cyanide is present, will pass into solution at once and will never appear in the solid state; but if cyanide is not present in sufficient quantity, then the zinc compound (white precipitate) will be formed in the solid state and will remain adherent to the zinc from which it was formed. This once having appeared in the solid state, it is often difficult, if not impossible, to redissolve it by increasing the amount of cyanide. It is one thing to keep a substance in solution, but it is quite another thing when once out of solution to get it back again into solution.

Another way to get white precipitate is to let solutions become acid. Then the complex zinc salts in the solution are decomposed and precipitated on the zinc. White precipitate is a complex body because it is formed from solutions essentially complex; it is not by any means simply zinc cyanide or zinc ferrocyanide.

Origin of "White Precipitate"

Zinc in water soon becomes coated with oxide, and when solutions containing practically no cyanide (for example, water washes) go through zinc boxes trouble is often caused by the coating of oxide.

White precipitate is especially the result of uneven flow of solution through boxes; that is, when the solution flows through channels. Contributory causes are acid solutions and also those weak in cyanide and muddy solutions. The cyanide strength which is necessary for ore treatment, and therefore which leaves the ore, is not necessarily the strength which will keep the zinc box in order.

Foul solutions result from allowing the impurities in the solution to increase. These impurities should be kept at a safe constant point by seeing that the zinc-box work is so good that a certain percentage of the precipitated working cyanide solution can go to the dump each day as moisture contained in the ore residues. The constituents of the ore itself often help to keep down the impurities in the working solutions.

The many and various troubles in connection with zinc-box work are less frequently heard of now because ore treatment is different and is generally better understood; and as a result the solutions entering the zinc boxes are correct and suitable for the purpose. Zinc-box work is therefore carried out under different conditions. From whatever varieties of filtering, leaching or decantation operations the cyanide solutions are derived, the cause of any zinc-box trouble is usually to be found in one or more of the following: Solutions entering the zinc boxes which do not contain free caustic alkali or which even contain free acid; soluble magnesium salts in the ore or in the water used; copper in solutions; the use in the zinc boxes of cyanide containing alkaline carbonates or sulphides; allowing the hydrogen, etc., generated in the zinc boxes to accumulate instead of insuring its liberation and escape about as fast as it is formed; greasy or oily zinc shavings; turbid solutions due to damaged filter cloths or to dirty decanted solutions, or the solutions may merely contain very small quantities of flocculent or colloidal matter.

All these causes of trouble, to which others might be added, have ultimately the same result; namely that the metallic surface of the zinc is protected (insulated) from the solution by either a precipitate of some kind, by gas bubbles, by grease or by ore slimes.

Remembering that a solution is run into a zinc box in order to catch, say, 0.1 oz. of gold from each ton of solution and if only an equal weight of some other precipitate (and this is a very small quantity and might easily be dust blown in by the wind) is allowed to be added somehow for each ton of solution, then the working life of that zinc box is divided by at least two.

The Function of Alkalies

Any solutions that do not contain free caustic alkali (lime) or which contain free acid may carry in solution silica, magnesium and aluminum salts, iron compounds and organic matter, which last colors the solutions. These substances can be carried only in acid or neutral solutions and will be deposited on the zinc shavings, and partly as a surface scum in the zinc box, as soon as the solution during the process of working becomes alkaline. As a result the zinc shavings will be more or less coated and will, to an increasing extent, cease work.

Magnesium salts are not rapidly precipitated by caustic lime, and therefore a solution might leave the ore alkaline and yet still later on deposit a small remaining quantity of hydrated-magnesium compounds. The organic matter usually derived from ore that has been on the surface for a long time gives the solutions a deep-brown color, but all this organic matter is precipitated by caustic lime, leaving the solutions gin clear.

If every solution before it left the ore were alkaline with caustic lime, all the substances referred to would

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have been precipitated right in the ore, and would remain there in their proper place. But if, for however short a time, any solutions not containing free caustic alkali are allowed to enter the zinc boxes, then such solutions will be made alkaline either by the working of the zinc boxes or by admixture with other solutions entering the same box, and as a result will deposit their precipitates or scum in the box.

The point to keep in front of one is that the mixed solutions entering a zinc box need not contain free acid in order to do harm, but every one of the various solutions which, when mixed together, constitute the feed for a box must of itself, before it leaves the ore and therefore before mixing with any other solution, contain caustic lime, otherwise precipitates will form in the zinc box.

In regard to copper in solution, this subject is a special one, but in general, copper "plates" on the smooth side of the zinc shavings, and where the copper does "plate" there is no further precipitating action, because the zinc is no longer exposed to the action of the solution. Lead acetate and other means are employed in order that the surface of the zinc shall be roughened, so that the copper, etc., deposits as a slime and not as a "plating deposit."

Trouble Caused by Carbonates

When cyanide containing alkaline carbonates or sulphides is added to the cyanide solution entering the zinc box, either in the solid state or by dripping in a strong solution, since the solutions contain both lime and zinc compounds, there are formed by double decomposition calcium carbonate and zinc sulphide. The former crystallizes on the zinc shavings and is easily felt by the roughness to the touch; the presence of this carbonate of lime will subsequently increase cleanup costs, etc. The zinc sulphide forms a flocculent precipitate, much of which settles on the zinc. The remedy is to be found in the actual buying of the cyanide. Carbonates in cyanide should not be reckoned as protective alkali—the only protective alkali is that which will absorb HCN, and this must be caustic lime or caustic soda. This latter is seldom used on account of its price; it has also other properties that are often a disadvantage in cyanide work.

It used to be no uncommon sight to see frames put on the top of the zinc shavings in order to hold down the zinc, so great was the buoyancy due to the large quantity of hydrogen held by it. The hydrogen that is held mechanically by the zinc shavings renders much of the zinc useless, as the solution cannot touch it. It causes the solution to run in channels, finding the path of least resistance. There is a distinct difference of opinion among engineers. Some pack the zinc shavings as tightly as possible, and gas cannot escape unless the zinc is frequently disturbed and the highly packed zinc causes resistance to the passage of the solution resulting in channeling of the solution, and therefore some of the zinc is out of action.

The best results in all ways are found when the zinc is laid as loosely as possible. There is thus less zinc to handle, the gas escapes with very little attention as fast as it is formed, and the gold slimes fall down more easily under the screen. Under these conditions there is nothing to cause the solution to run in channels, and thus all the zinc may be in action. Channeling of solution is tested for by coloring with aniline dye the solution which enters the box and watching its progress.

The siliceous and other matter which thus gets into the zinc boxes stops the precipitation by coating the zinc. No matter how the cleanup is done, all the siliceous matter that is in with the zinc has ultimately to be smelted, and it will increase the slags, the labor, the values temporarily held in suspense and therefore the costs all round. The remedy is to arrange so that, when filter cloths fail, the muddy solutions cannot get into the zinc boxes.

Value of Keeping Zinc Clean

The sum total of all zinc precipitation is that the zinc works satisfactorily so long as the zinc in the precipitating arrangement, whatever it may be, is metallic zinc, and that the actual clean metal surface is directly exposed to the circulating cyanide solution. As this metal surface becomes coated or protected in any way from the cyanide solution, the efficiency of the precipitation drops. The efficiency is at any time, other things being equal, directly proportional to the area of the clean metal surface exposed.

Gold and silver also, as thrown out of solution by the zinc, naturally gradually cover and protect zinc from contact with cyanide solution, and therefore, all other conditions being in order, all or part of the zinc may cease to work because there is too much gold or silver in the box, part or all of which requires to be cleaned up.

In early cyanide days boxes were cleaned up only when the bullion had to be produced—usually once a month. Later, on, the position became different, and it was recognized that boxes, to work well, had to be cleaned up more frequently, and now the practice is two or three times per month. Cleaning up has never, even under the best of working conditions, been an exceptionally cleanly or show operation. Zinc shavings as used in zinc boxes, of any of the various patterns, exhibit many defects, of which the following are the principal: The amount of zinc actually consumed is enormously above the amount theoretically demanded for each ounce of gold or silver; none of this excess zinc is recovered; handling of the zinc and gold slimes is considerable and possibilities of loss are therefore increased; there is a loss of interest on money, due to the gold and silver values held in suspension in the zinc boxes; the frequent cleaning up and all the unsatisfactory handling is due to the fact that there is no satisfactory means of removing, mechanically or otherwise, all the precipitates of whatever kind from the zinc, as fast as such precipitates are formed, thereby leaving the zinc surface always clean for further action.

For some years past zinc dust has been used largely, and in some respects it possesses advantages over the shavings. There are disadvantages, such as its rapidity of oxidation and varying percentage of metallic zinc.

It is not clear that the use of zinc shavings has reached finality—there appears to be room for a more standardized method of clean-up, embracing a means of removing the precipitates from the shavings as fast as formed thereby eliminating the handling of the zinc, the values in suspense in the boxes and excessive zinc consumption.

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The Uses to Which Graphite Is Put are numerous and constantly increasing in number. A prominent industrial authority has estimated that the proportion applied to the different purposes is about as follows, according to W. L. Whitney, of the United States Graphite Co.: 55% for making crucibles, 15% for stove polish, 10% for foundry facing, 5% for lead pencils, 5% for paints, 5% for lubricants and 5% for all other purposes.

Operating a Steel-Sharpening Shop*

By J. E. O'Rourke†

Those engaged in rock excavation are beginning to realize more clearly every day the need of a well-equipped blacksmith shop for sharpening rock-drill bits. When hammer water drills were adopted at the Wisconsin Zinc Co.'s mines near Platteville, Wis., the management realized that hollow high-carbon drill steel required much greater care in handling than the solid steel formerly used with piston drills. Considerable thought was given this matter, resulting in the erection of a new blacksmith shop at the Champion mine. The site of this shop was carefully selected so as to be as nearly centrally located as possible, in order to furnish steel to four mines—namely, the Champion, Longhorn, Thompson and the Winskell.

Appreciating the fact that four mines were liable to keep the blacksmith very busy, it was endeavored to arrange the shop equipment in such a manner as to avoid excessive handling of steel. With the idea of getting the greatest efficiency as regards the heating and the making of drill bits and shanks it was decided to install a Denver Fire Clay Co.'s oil forge and a Sullivan sharpener.

Attention is called first to the rack, Fig. 1, for dull steel from the Champion mine, the shaft of which is located about 50 ft. from the south end of the shop. When the dull steel is hoisted from the Champion shaft, it is carried to the shop, and each length is placed in the respective compartment allotted for it on the dull-steel rack, the longer lengths being placed in the lower compartments.

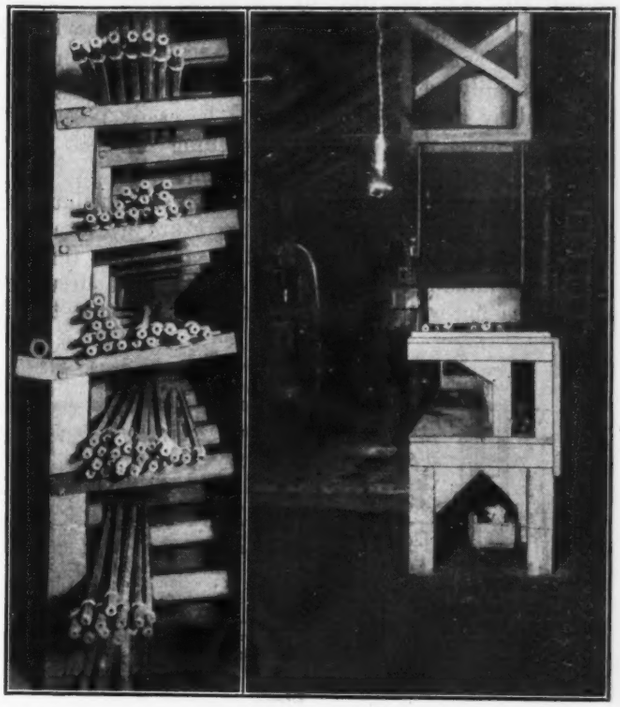
The movement of the steel through the shop from this point is as follows: From the dull-steel rack it goes to the upper deck of a double-decked stand in front of the oil forge, as shown in the plan, Fig. 3.

The fire opening in the oil forge is of sufficient length for placing nine steels in the fire at once. The writer experimented with different forging heats and, contrary to the recommendation of the steel manufacturer (which was 1,500° F.), it was determined that the most satisfactory forging heat was close to 1,650° F. A Wilson-Mauelen base-metal pyrometer was used. The fire end of this pyrometer was held in position in the fire by means of a home-made attachment (see Fig. 4) bolted to the forge cap.

Colonial steel was used, having the following analysis: Carbon, 0.88%; manganese, 0.35%; phosphorus, 0.011%; sulphur, 0.017%; scleroscope hardness, 0.44.

The blacksmith stands on the sharpener side of the double-deck stand shown in Fig. 3, with his helper on the opposite side. The smith takes a heated steel from the forge, and one step backward places him in position to operate the sharpener. The dressing of a bit requires about 30 sec.; however, it is not unusual to attain the completion of this operation in 20 sec. Much valuable time is saved by placing the finished bit on the lower deck of the double-decked stand, instead of following the old haphazard way of throwing it on the ground, where it will be in the way and must be picked up later.

I am, of course, well aware of the efficacy of an intermediate or refining heat to remove forging strains, previous to tempering, but owing to the heavy steel demand and the fact that satisfactory results were obtained with two heats, it was decided to dispense with the refining heat. Two methods of tempering were practiced: One was to lower the temperature by partly quenching and then drawing the temper to the desired color; the other method consisted of plunging the bits in a brine of sal ammoniac, saltpeter and bromide of potash solution covered with about 6 in. of Houghton's No. 2 soluble quenching oil, the bit not being withdrawn until thoroughly cooled.



FIGS. 1 AND 2. DULL-STEEL RACK AND THE DOUBLE-DECK STAND

It is well known that brine as a tempering agent causes much faster contraction of the molecules than water, which contraction sometimes has a disastrous effect on the bit when drilling in lime rock; however, this rapid contraction was somewhat retarded by a protecting film of oil. The bromide of potash offset the injurious effects resulting from overheating. The other ingredients of the solution were added to soften and purify the water.

After the steels were cool, they were removed from the tempering tank and placed on the adjacent sharp-steel rack with shanks in the direction of the grinder near the shop door.

The final operation consists in grinding the ends of shanks perfectly true and square. This work is done by a No. 2 Willey direct-connected bench grinder (James Clark, Jr., Electric Co., Louisville, Ky.) equipped with 12-in. wheels. After grinding, the steels are replaced on the sharp-steel rack, whence they are carried to the collar of the Champion shaft, which is only 50 ft. from the end of the shop.

*First-prize drill-sharpening article in the "Engineering News" prize contest, "Engineering News," Jan. 18, 1917.

†Engineer, American Zinc, Lead and Smelting Co., Granby, Mo.

Any mine operator who has ever tried to sharpen steels for two or more mines in one blacksmith shop will appreciate that it will be a matter of only a few days before one mine will have absorbed most of the steel, unless some steps are taken to prevent it. In order to provide against this, three double racks were erected along one side of the building. One of each of these sets of racks is open to receive the dull steel when it is brought from its respective mine. The other rack is protected by a wooden grating furnished with hinges and a lock. These locked compartments contain the sharp steel. A sufficient amount of steel is provided for each mine so that when a load of dull steel is delivered to the shop, it is counted and an equal amount of sharp steel is taken from the closed rack and returned to the mine, after which the dull steel is sharpened and placed in the closed rack under lock and key, awaiting the next day's demand. It can be readily seen that if the above system is religiously observed by the blacksmith it will be easily possible to keep the exact cost of steel sharpening for each mine, likewise the relative steel consumption.

The oil is stored in a pressure tank outside the building and is heated to the proper temperature by means of a coil placed in a stove, water being supplied to this coil from the mine-pump discharge column, and circulated through a hot-water jacket around the oil tank, thence

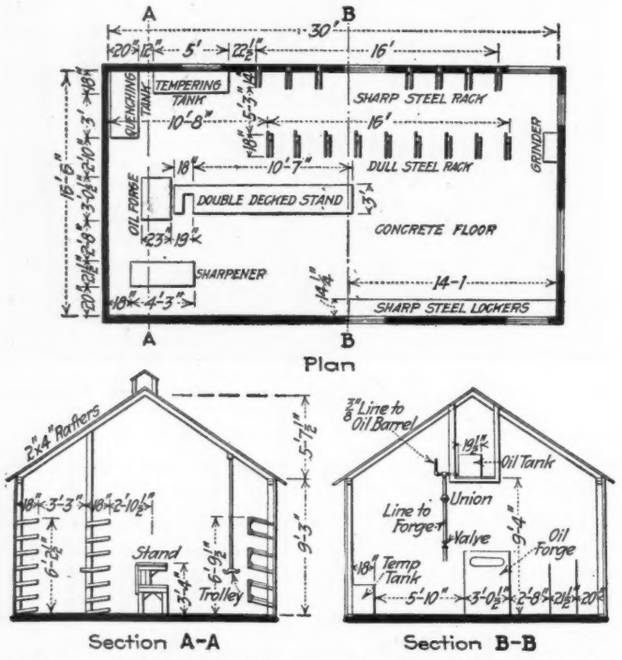


FIG. 3. DETAILS OF THE DRILL-SHARPENING SHOP AT WISCONSIN ZINC MINES

to the upper barrel, in which an oil reservoir tank is placed. In this manner a storage of about 50 gal. of warm oil is constantly provided.

Another kink consists of a trolley for supporting the drill-steel in the sharpener. A rail similar to a barn-door hanger is attached to the roof framing and carries two roller-bearing wheels in tandem, with a hanger between them from which is suspended a rod about 9 ft. long. The end of this rod is threaded to hold a double-swivel hanger (see Fig. 3), which can be adjusted instantly as to height. On this the drill-steel rests during the sharpening operation. Longer or shorter steels can be handled

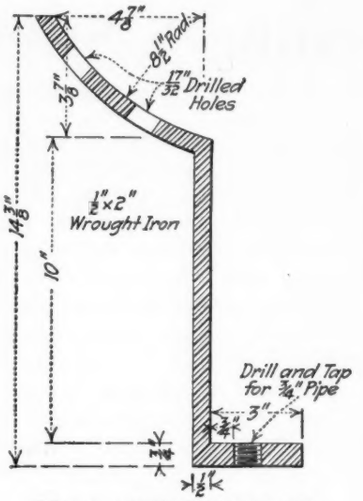


FIG. 4. ATTACHMENT OF PYROMETER TO FORGE

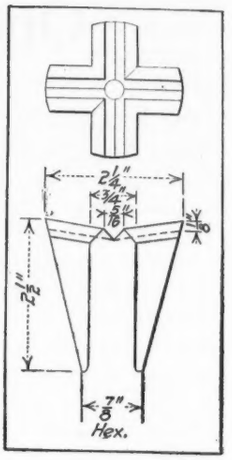


FIG. 5. DETAILS OF DOUBLE CROSSBIT

by running the trolley along its track. This eliminates the cumbersome tripod-steel support.

The type of drill bit used is shown in Fig. 5. It is the best bit for drilling Wisconsin limestone, when used in hammer drills, on account of its high penetrating qualities and ease of rotation.

An estimate of the total cost of this shop, with complete equipment including building, is approximately $2,300.

The writer is greatly indebted to Douglas C. Corner, former Superintendent of the Champion mine (now a member of the engineering staff of the American Zinc, Lead and Smelting Co., Granby, Mo.) for his kind assistance in preparing this article.

Composition of Average Igneous Rock

The earlier computations on the composition of the average igneous rock were made by finding the mean of a large number of analyses, writes Adolph Knopf, in the *Journal of Geology*, Vol. 24, p. 630 (*Chem. Abstr.*, Jan. 20, 1917). In this method each analysis receives the same weight, regardless of the size of the geologic body it represents. The present computation was made by dividing the area occupied by each rock species by the total area of igneous rocks (16,728 sq.mi. as mapped in the Cordilleran and Appalachian folios of the United States Geological Survey—Daly's "Igneous Rocks and Their Origin," Table 4) which gives a weight factor. This factor, multiplied by the average composition of the species gives the per cent. contribution of that species to the composition of the average igneous rock. The composition thus calculated (Column 1) checks fairly closely with Clark's average (Column 2):

	1	2		1	2
SiO_2	61.64	60.47	CaO	5.06	4.88
TiO_2	0.73	0.80	Na_2O	3.40	3.41
Al_2O_3	15.71	15.07	K_2O	2.65	3.03
Fe_2O_3	2.91	2.68	H_2O-	1.26	0.48
FeO	3.25	3.50	H_2O+		1.44
MnO	0.16	0.10	P_2O_5	0.26	0.29
MgO	2.97	3.85			

Prospecting and Mining of Copper Ore at Santa Rita, N. M., is the title of Bulletin 107, just issued by the Bureau of Mines in coöperation with the United States Geological Survey. This bulletin describes the situation and general geography of the Santa Rita district, the ore deposits, the adaptation of mining methods to geology and topography, prospecting and locating orebodies, churn drilling and sampling, and mining. Copies may be obtained for 25c. from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Investigation of Rock Crushing*

The aim of the laboratory experiments described in this paper was twofold: To measure as accurately as possible the maximum amount of crushing that can be effected by 1 hp. acting for 24 hr., by two proposed methods for measuring the amount of crushing, namely—(a) by Rittinger's method; (b) by Stadler's method, based on Kick's law; and to show, if possible, that by one of these methods the amount of crushing produced by 1 hp. in 24 hr. is constant throughout a wide range in the diameter of the piece crushed, and that by the other method the amount of crushing is a variable quantity over the same range of diameter, or else show that neither of the proposed methods for measuring the amount of crushing indicates a fixed relation between power and crushing and consequently a new method for computing this amount will have to be found to permit the establishment of a law of crushing.

Experimental Methods

Testing machines, calorimetric methods and commercial types of rock-crushing machines were considered with reference to their value for measuring power used in crushing. The following electrically driven crushing machines, installed and available in the McGill ore-dressing laboratory, which had been used in previous rock-crushing tests, on the whole seemed especially suited to the investigation: Comet "A" crusher; 7x9-in. Dodge crusher; 10x16-in. rolls. In later tests a 3½-ft. Huntington mill was used.

In all the series of tests except one, the rock crushed was a tinguaite—an intruded eruptive obtained from a local quarry. It is a hard and brittle rock, with a tendency to break rather more easily in one plane than in another at right angles to it. It, therefore, is inclined to break in slabs, although the fractured pieces are always irregular in shape.

Crushing Tests Made In 1914

In 1914 three series of tests were made to measure the work done per "apparent effective horsepower in 24 hr." In the first series the laboratory Comet "A" crusher was used; in the second series, the Dodge crusher; and in the third series, the rolls.

In certain respects the results of these tests were unsatisfactory, but the data obtained indicated strikingly

TABLE 1. SUMMARY OF THE MOST EFFICIENT OF THE 1914 TESTS

Test No.	Crusher	Diameter of Piece Crushed, In.	Work Done per A.E. Hp.* in 24 Hr. Measured in Stadler E. U.†	Measured in Rittinger S. U.‡
6	Gyratory	3.50	710	947
27	Dodge	1.20	520	1,030
34	Rolls	0.50	286	1,128
41	Rolls	0.29	138	1,000
47	Rolls	0.18	68	1,022
48	Rolls	0.11	89	1,187
49	Rolls	0.07	52	823

Total range, 50 diameters. Range in roll tests, 7 diameters.

* Apparent effective horsepower. † E. U. = energy units. ‡S. U. = surface units.

the probability of a fatal error in Stadler's method and a degree of reliability in Rittinger's. The figures showed an enormous variation in the amount of crushing done by a measured horsepower through a wide range in diameter when calculated by Stadler's method, based on Kick's law, and a remarkable constancy when calculated by the law proposed by Rittinger in 1867. The comparative figures in Table 1 justify fully the indicated, but not necessarily proved, outcome of the whole investigation.

Roll Tests Made In 1914-15

In the fall of 1914, the fourth series was commenced to investigate in more detail the effect of "tonnage" and "work done per ton" before adopting a set procedure for the final series with rolls.

The decrease in efficiency which results by increasing the feed tonnage or by increasing the crushing work per ton, for sizes 0.46 in. diameter and upward, was clearly indicated by the results obtained.

The sudden increase in efficiency when the feed diameter is reduced to 0.30 in. is explained by the marked change in the sound and vibrations emanating from the machine. When crushing 0.46-in. feed at the 30-ton rate, the vibrations in the laboratory concrete floor were perceptible 20 ft. distant from the rolls. When crushing 0.30-in. feed, the floor vibrations practically disappeared, and there was a marked diminution in the smashing shocks, resembling a series of explosions, which were so pronounced during crushing of the larger feeds. In the next and succeeding smaller sizes the characteristic sound effect may be described as being in the nature of a steady grinding noise, indicating that a more uniform pressure replaces the fluctuating and violent forces transmitted to the journals during the crushing of the larger pieces. That there should be a decrease in machine efficiency under the stated circumstances, and an enormous one, is in the author's opinion opposed to reason and common sense, and yet that is the one and only conclusion that can be reached by acceptance of Stadler's theory based on Kick's law, as will be apparent by examination of the data in Table 2.

TABLE 2. SUMMARY OF RESULTS OF 1914-15 ROLLS TESTS

Test No.	Remarks	Diameter Feed, In.	Tons Crushed in 24 Hr.	Work Done per Ton, Rittinger S. U.	Work Done per A. E. Hp. Stadler E. U.	Work Done per A. E. Hp. Rittinger, S. U.
50	.....	1.00	12.2	6.9	623	1,198
53	.....	0.70	10.2	9.8	472	1,192
60	.....	0.46	5.8	20.6	272	1,097
79–88	Average 9 tests*	0.30	28.7	21.3	190	1,002
89–93	Average 5 tests	0.19	31.3	30.9	150	1,115
94–97	Average 4 tests	0.12	33.8	22.6	109	1,054
98–101	Average 4 tests	0.08	34.5	31.8	82	1,028
102–105	Average 4 tests	0.05	31.6	21.5	77	1,137
106–109	Average 4 tests	0.03	29.8	28.0	77	1,250
Range, 33 diameters.		Average R.S.U., 1,120.				

* Test 86 excluded.

The Stadler energy unit varies, depending not only on the diameter of the feed, but on the work done per ton as well. In tests 50-53 the "work done per ton" is less than in the remaining tests (see Table 2) and the Stadler efficiency increases correspondingly.

It follows that there are an infinite number of values of this apparently misnamed "energy unit of crushing," consequently it is not a unit indicating a fixed relation between power and crushing when the material crushed is rock, however applicable it may or may not be in estimating the power required to crush an ideal and more or less imaginary substance. The unavoidable conclusion to be drawn from the experiments is that the Stadler energy unit is of no value in determining the relative efficiencies of various types of rock-crushing machines. For a single machine, crushing feed of limited range in

*A paper to be read at the New York meeting of the American Institute of Mining Engineers. It is an abstract of a paper prepared for publication in the "Transactions of the Canadian Mining Institute," giving an account of an experimental investigation of the theory of rock crushing made by John W. Bell, M. Sc., W. G. Mitchell, M. Sc., P. P. Baily, M. Sc., and W. E. Cockfield, M. Sc., in the ore-dressing laboratory of McGill University, Montreal, Canada. This paper is a continuation of the discussion of the relative value, for measuring the efficiency of crushing machines, of Kick's law (advocated by Stadler) and Rittinger's theory (advocated by Gates).

diameter with only a small variation in the work done per ton, Stadler's theory, based as it is on one of the manifestations of crushing, shows the character of the changes in efficiency produced by changes in adjustment, but the Rittinger system, even if it fails to conform with a law, is preferable by reason of its greater sensitiveness to small variations in the amounts of crushing.

The sudden increase in the work per apparent effective horsepower in the last four tests (see Table 2), indicated the importance of investigating the relation of power and the crushing of rock particles of very small diameter. Some preliminary work convinced us that a Huntington mill was admirably suited for the investigation, and this machine, with some modifications, was accordingly used.

TABLE 3. SUMMARY OF AVERAGE RESULTS, HUNTINGTON MILL TESTS

Test No.	Remarks	Grade	Diameter Feed, In.	Work Done per A. E. Hp. Stadler E. U.	Work Done per A. E. Hp. Rittinger S. U.
114–115	.....	+ 20	0.031	55.0	1,590
116–119	.....	+ 30	0.020	47.5	1,860
120–122	.....	+ 40	0.014	45.5	2,030
125–127	.....	+ 60	0.009	34.2	1,970
128–129	Test 130 excluded	+ 80	0.007	28.1	1,910
131–132	.....	+100	0.005	20.2	1,800

Range of diameter tested, 6.

The results in Table 3 show the characteristic drop in Stadler units per apparent effective horsepower, although the range of diameters tested is not large. However, many more experiments would be required to determine the effect of alterations in tonnage, percentage of water in pulp, speed of machine, etc.

Test 116 was made to obtain an indication of the effect of a reduced tonnage. The number of Rittinger units appears to increase, but several check tests would be required to form a definite conclusion.

Considered as a whole, the results are in closer agreement with Rittinger's theory than could be expected, when two obstacles which conspire to defeat the purpose of the investigation are taken into account. One is the difficulty of measuring the power used only in crushing. The second has to do with the measurement of the surface in the —200 grade. Nobody has yet made a reliable measurement of this, and it is probable that it is a variable factor. For the —200 grade Stadler's ordinal number 28 was adopted, for although it was realized that it was not necessarily an accurate estimate of the average volume of the particles it was supposed to represent, it would at least serve to make the comparison as fair to one as to the other theory. The corresponding Rittinger number is 780, which was adopted. It is probable that the average factor is appreciably greater than 780.

If, in going from coarse to fine crushing, there is a considerable decrease in surface in the —200 grades, the results tabulated in this paper would be appreciably affected, although the effect of such a variation would be more disastrous to Stadler's theory based on Kick's law than to Rittinger's, and the Stadler units per apparent effective horsepower might in consequence approach perilously near to zero.

In this investigation the desirability of crushing a quartz gangue was recognized as being of more interest to those engaged in practical work; unfortunately, however, none was obtainable locally, and tinguaite was employed for the experiments. It was feared that to some extent the habit of fracture of tinguaite might have prejudicially influenced the results obtained, hence upon the conclusion of the Huntington mill tinguaite tests, a series of grades of quartz sand was prepared and used to determine this point.

The results obtained furnished convincing evidence that the relation between power and crushing indicated by the tinguaite tests remains unchanged when the rock crushed is quartz, excepting that the crushing force is less.

When it is considered that Gates, using a testing machine, obtained similar results for three entirely different rocks, a sufficient amount of experimental data now seems available to justify the following conclusions:

1. That in the reduction of any given rock there is a constant relationship between the power applied and the crushing effected.

2. That Rittinger's theory appears to conform agreeably with this relationship.

3. That Stadler's theory based on Kick's law does not so conform.

The Ekibastus Smelting Plant

In the annual report of the Irtysh Corporation, Ltd., the progress in building and putting into operation the great zinc and lead-smelting plant at Ekibastus, Siberia, which is to treat the ore of the Ridder mine, was summarized.

In the zinc plant proper the first duplex Merton calciner started in May, 1916, and one block of retorts followed in August. The zinc-distillation furnaces are of modern type, gas-fired and regenerative. Each block has an estimated output of 150 tons of spelter a month. The ordinary troubles to be expected in the starting of a new plant are gradually being overcome; the men are getting used to their work, experiment is demonstrating the proper proportion of the various clays for the retorts, and the amount of material treated is being increased. For the first eight weeks of operation the output of spelter was about 90 tons, and the management is looking forward to a rapid increase in this up to full capacity. Additional calciners are nearing completion, and a second block of zinc retorts was to be ready by the end of 1916.

The plant has been laid out for an installation of 20 blocks of zinc furnaces, of which it is expected to have six completed by the end of 1917. The site lends itself admirably to this and to still further extension.

Construction work on the lead-smelting plant is well advanced. The smaller of the two blast furnaces should be ready to go into commission early in 1917 and the larger one during the summer. The greater part of the auxiliary plant and machinery is already on the ground. This plant will treat the lead concentrates received from Ridder and the residues from the zinc retorts.

Adjacent to the lead plant a lead refinery is being erected. This also is well forward, and the machinery was all to be on the ground before the end of 1916. It will consist of softening and drossing furnaces, desilverization kettles, a Howard press and stirrer and a tilting furnace for the distillation of the zinc crusts from the desilverization kettles. The bullion refinery will produce pure gold and silver. Work on the bullion refinery is advancing, and should be completed as soon as needed.

The 80 miles of broad-gage railway between Ekibastus and the Irtysh River (Ermak) has been further improved and the rolling stock augmented. In addition to the transport of supplies and concentrates to Ekibastus, the railway carries coal and coke to Ermak, whence it is shipped by river.

The Assayer and Chemist

A Handy Method for Assaying Tin Ores

By George M. Henderson*

During the course of an examination trip in Bolivia, I had occasion to make a large number of tin assays. At first an attempt was made to use the common Bolivian method—the crucible fusion using KCN as a flux. But this was soon given up, because its use on low-grade ores was found to be out of the question—trustworthy results could not be obtained.

After some experimenting a wet method was adopted, using sodium peroxide for flux. The melt was made in a nickel crucible, then dissolved in HCl, reduced with nickel, and the reduced solution was titrated with a standard solution of iodine.

All went well until the nickel crucibles were found to be attacked, and after several fusions, the bottoms dropped out. This was rather a serious predicament, as we were just starting the examination of a large property, which would necessitate the determination of several hundred samples. Nickel crucibles were obtainable only from the United States, and it would require at least a month to secure a new supply.

So the problem was to find some container near at hand in which to make the fusion. After trying various things a small scorifier was used, and it was found not only to answer the purpose, but also to improve the former procedure with the nickel crucibles by increasing the speed of the analysis. The procedure finally adopted was as follows:

Weigh out 0.5 gram of ore ground through 100-mesh. If the ore is oxidized, mix directly with five times its weight in a 1½- or 2-in. scorifier. In case the ore contains sulphides, weigh the ore and then roast in a muffle. After the roast is completed, remove from the muffle, cool and mix in the peroxide. The mixed peroxide and ore is then put in the muffle and allowed to remain until entirely liquid. The scorifier should not be left in the muffle too long after the mass is liquefied, or an incrustation will be formed that is insoluble in HCl.

After cooling, the scorifier is dropped into a 400-c.c. beaker, containing about 100 c.c. of distilled water. The beaker should be covered with a large watch glass, to prevent spattering. After all action has ceased, remove the scorifier and wash out with water and 60 c.c. of concentrated HCl and pour the contents of the beaker into a 500-c.c. Florence flask. The fused mass should dissolve completely and leave a clear, yellow solution. The volume of the solution in the flask is made up to about 250 c.c. with distilled water.

The solution is then reduced by boiling with a coil of thin, sheet nickel. After the reduction is completed, the flask is cooled and the titration with standard iodine solution made.

*Mining engineer, Weston, Mass.

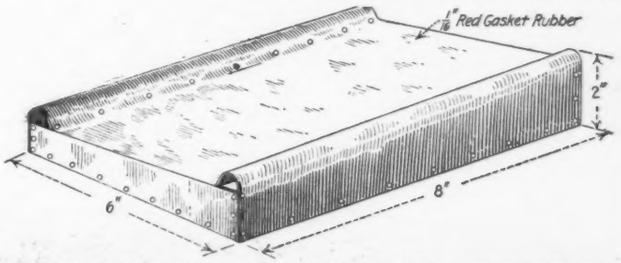
This method has been adopted by a number of the tin-mining companies in Bolivia. M. G. F. Sohnlein, mill superintendent of the Compañia Minera de Oruro, at Machacamaraca, Bolivia, has made a thorough test to determine its accuracy. In an article in the *Revista Minera*, of Bolivia, he gives the following results obtained:

COMPARISON OF TIN ASSAY METHODS

Method Used	Sample No. 1, % Tin	Sample No. 2, % Tin	Sample No. 3, % Tin
Fusion with sodium peroxide in scorifier	5.06	22.45	0.94
Fusion with sodium peroxide in nickel crucible	5.01	22.50	0.94
Berringer-Hutchin method	5.06	22.40	0.94
Fusion with KCN	3.40	22.20	....

Lead-Precipitate Drain Board

In the assay of cyanide solutions for gold and silver the lead precipitate, after having the excess zinc dissolved by hydrochloric acid, is ready for water washing and cupellation. At a mine in Nevada difficulty was encountered in getting this precipitate together without losing small particles in washing and decantation. To facilitate the gathering of the precipitate the sloping



A BOARD THAT PREVENTS LOSS OF LEAD PRECIPITATE

drainboard shown in the accompanying sketch was designed at the plant by the assayer for the company. It consists of a plain block of wood covered with $\frac{1}{16}$-in. red gasket rubber.

The precipitate and the small amount of water remaining in the beaker after the bulk of it had been decanted are poured onto the rubber surface. The lead precipitate, which adheres to the surface, while the water flows off, can be easily gathered and pressed into the shape of cubes ready for cupellation.

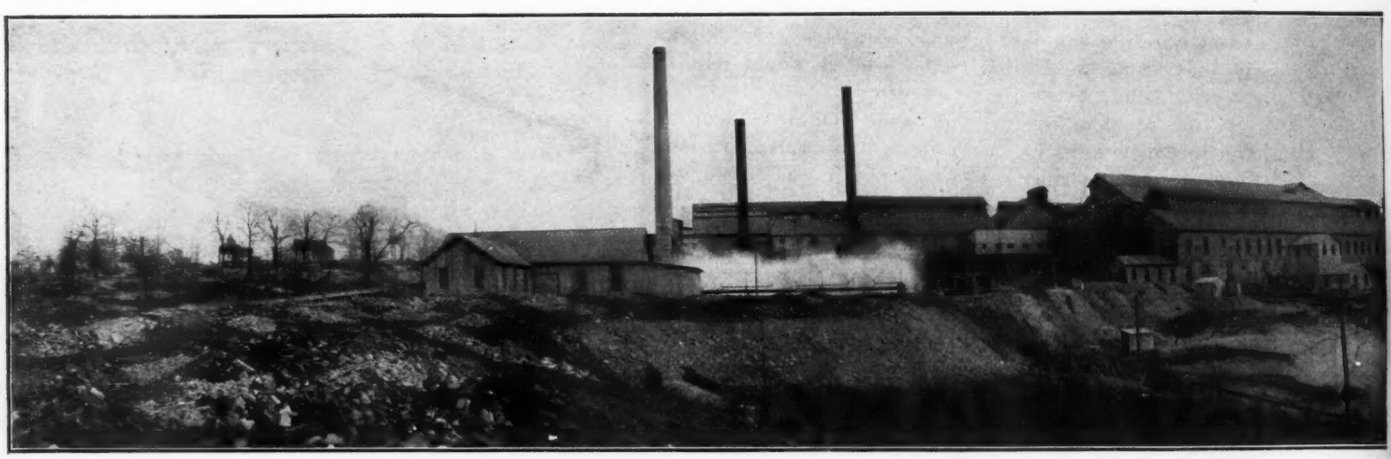
Field Test for Phosphates

For field tests on supposed phosphate rock the U. S. Geological Survey is now recommending that the fresh rock surface be moistened with a drop of 1:2 HNO_3 and then a crystal of ammonium molybdate be placed on the wet spot (Mineral Resources of the United States, 1915, Part II, p. 242), rather than the usual method of bringing the rock into solution. A rough estimate of the amount of P_2O_5 in the rock may be made by comparing the spot produced with some standard samples.

Oil Does Not Wear Out, but does need treatment to cleanse and purify it. Vegetable oils will wash out of fabrics, but mineral oils will not.

Views at St. Joseph Lead Co.'s

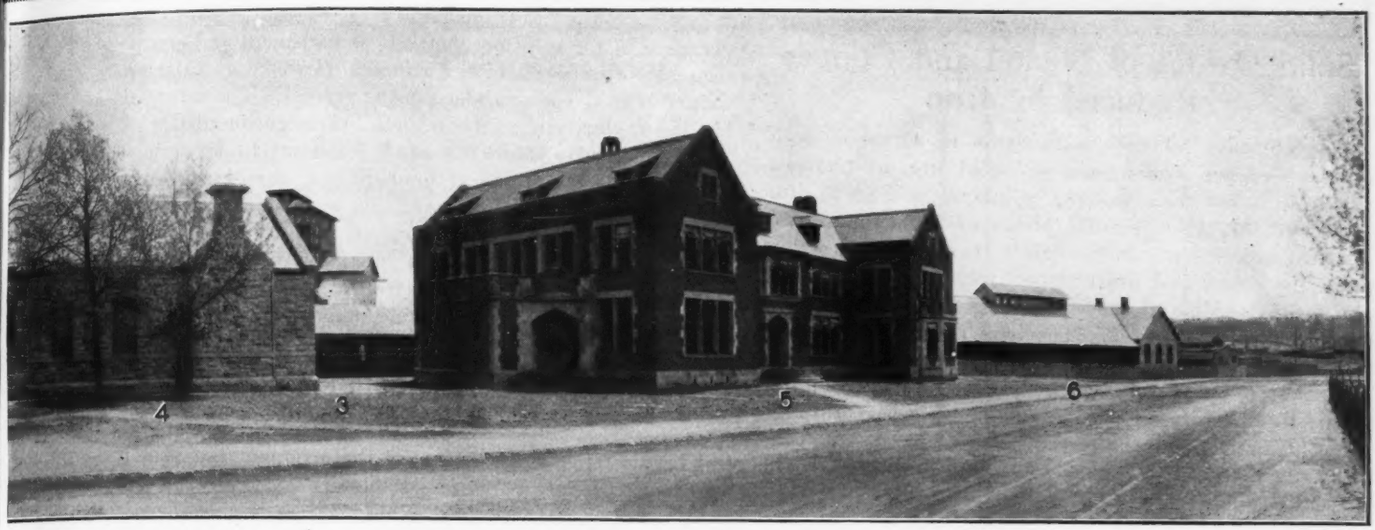
BONNE TERRE, MO., THE HEADQUARTERS OF THE ST. JOSEPH
1—Bonne Terre Farming and Cattle Co. office. 2—Mississippi River & Bonne Terre Ry. office. 3—Bonne Terre



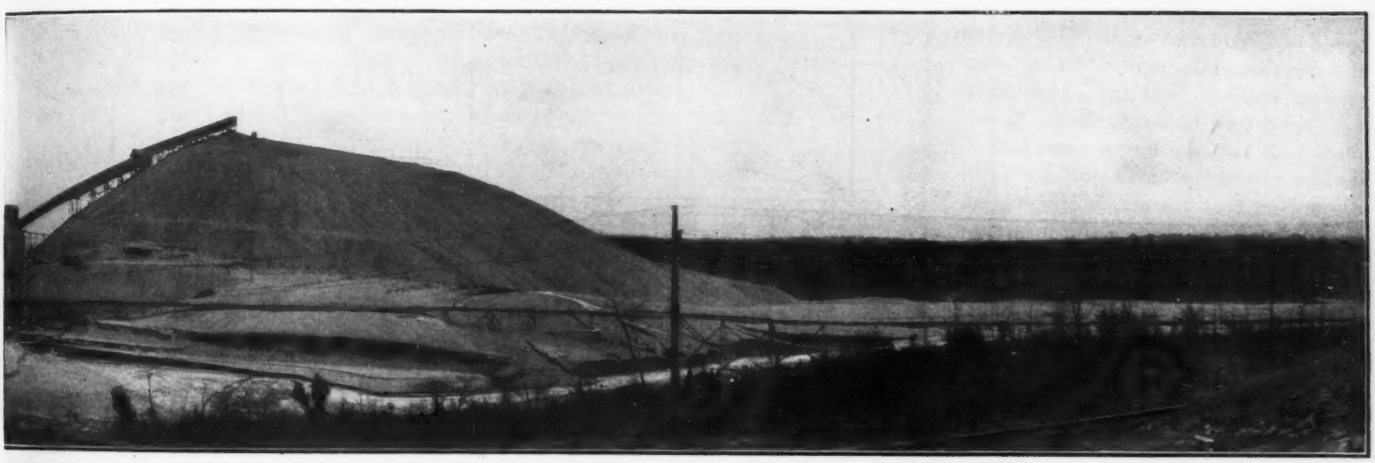
ST. JOSEPH LEAD CO.'S MILL AT LEADWOOD, IN ST. FRANCOIS COUNTY, THE CENTER

RIVERMINES MILL OF DOE RUN LEAD CO., A SUBSIDIARY OF

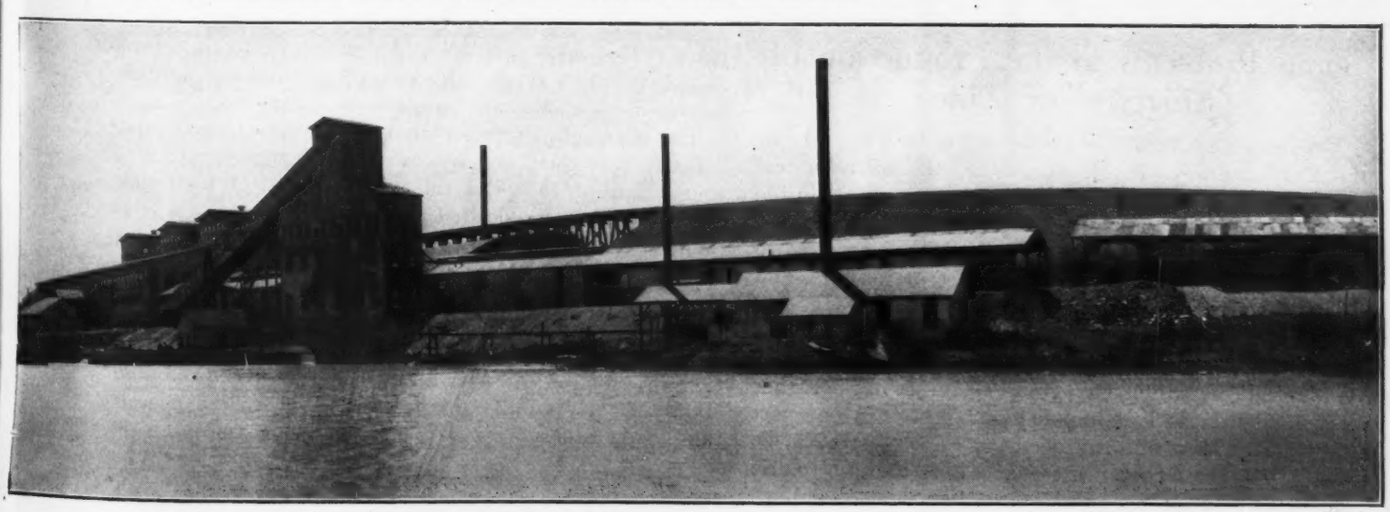
Operations in Southeastern Missouri



LEAD CO., THE LARGEST LEAD-MINING COMPANY IN AMERICA
concentrating mill. 4—Bank. 5—St. Joseph Lead Co. offices. 6—Storehouse for Bonne Terre mill



OF THE DISSEMINATED LEAD FIELD OF SOUTHEASTERN MISSOURI



THE ST. JOSEPH LEAD CO., AT RIVERMINES, MISSOURI

Details of Milling and Smelting

Solid Oxides of Nickel and Copper Reduced by Iron

To determine whether solid oxide of nickel or solid oxide of copper would react on solid iron at temperatures far below their melting points, according to *Iron Age,* Dec. 21, 1916, several pieces of 1-in. round bars of Armco iron containing 0.02% carbon were drilled down the center and filled respectively with nickel oxide and copper oxide and consolidated by forcibly driving in a plug of the same iron. The bars thus prepared were placed in a muffle furnace and heated to about 1000° C. for about 6 hours for 3 days. When drawn from the muffle they were sectioned by sawing vertically through the center and then examined.

Dr. J. E. Stead, who made the experiments and who presented the results to the Iron and Steel Institute at its autumn meeting in London, Sept. 22, 1916, offered the following conclusions: It has been proved that solid iron is capable of reducing solid oxide of nickel and oxide of copper to the metallic state with the formation of iron oxide. That the interchange is not confined to the surfaces of contact, but extends for a considerable distance from the surface of the iron, suggesting that there is interdiffusion of iron and nickel and iron and copper, and of the oxides of these metals. That surface tension plays an important part in causing the reduced metals and the oxides to segregate into coherent independent masses. There is some evidence that the reduced metals, copper and nickel, are alloyed with some iron. More research is being made to determine whether this is so.

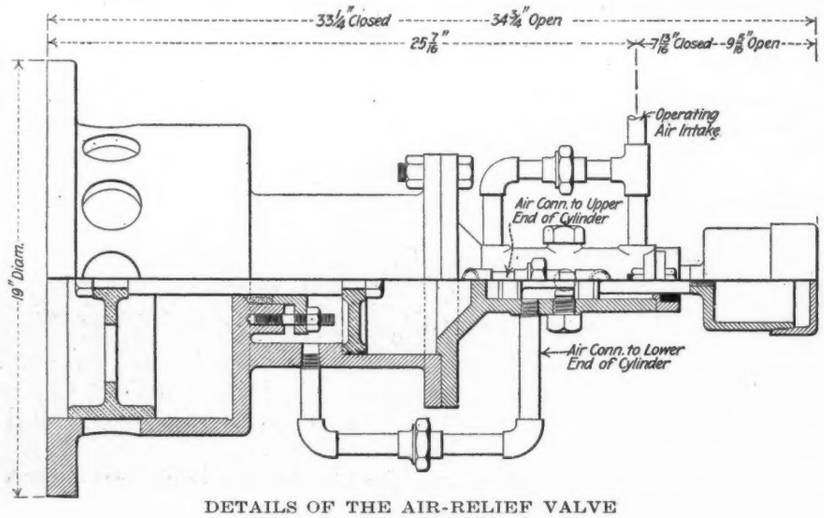
Some Problems in the Production of Electrolytic Zinc

With reference to the production of electrolytic zinc at the Trail refinery, E. H. Hamilton, the metallurgical manager, makes the following interesting comments in the annual report of the Consolidated Mining and Smelting Co. of Canada. The preliminary operations involve extremely fine grinding of the ore, careful roasting, and leaching, with thousands of tons of solution of varying degrees of acidity, and the elimination of the impurities from the solution before electrolysis. The iron, copper, lead, arsenic, cadmium, etc., go into solution in the earlier stages and have to be eliminated into less than one part in 100,000. Most of these elements were reported to be absent from the Sullivan ore—for which the electrolytic zinc plant was erected—and when they made their appearance in the solution, methods of treatment and equipment had to be devised for precipitating and filtering them out in the proper place in the process. The repeated handling, clarifying, filtering, etc., of large quantities of muddy, corrosive solution made it necessary to devise new pumps, etc. Questions of temperature, current, etc., in the electrolytic room were overcome successfully, and the process is now working satisfactorily and can be extended indefinitely, producing zinc of great purity. Manganese dioxide is now being produced from the Sullivan ore, as a byproduct in the electrolytic zinc refinery.

A Good Air-Relief Valve

By Lindsay Duncan*

The air-relief valve shown in the acompanying sketch has been found to be more satisfactory for turbo-blowers and blowing engines on converter service than any type of valve which could be purchased in the open market. It is used by the Nevada Consolidated Copper Co. in its plant. The valve is quick and positive in action, opens and closes under small differences of pressure and permits a large volume of air to escape when open.



DETAILS OF THE AIR-RELIEF VALVE

The essential principle is that of a large balanced valve actuated by a small and accurately made pilot valve. The weight box of the pilot valve is partly filled with shot so as to open at the desired pressure. The operation is as follows: The pilot valve rises with excess air pressure and uncovers a port admitting the compressed air below the main operating piston, which in turn rises, lifting a balanced piston in the lower compartment and uncovering twelve 2½-in. circular relief ports. When the pressure drops a fraction of a pound, the pilot valve drops and simultaneously admits compressed air above the operating piston and uncovers a port relieving the pressure

*Mechanical engineer, Nevada Consolidated Copper Co., McGill, Nev.

below it. The operating piston then drops, and the relief ports are instantly closed.

The valve bodies are made of cast iron, the pistons of brass, and the double piston pilot valve is turned out of a single piece of cold-rolled shafting. This valve was designed by me and built in the McGill shops of the Nevada Consolidated Copper Co. It is not patented.

Design of a Thousand-Foot Smeltery Stack

By N. L. Stewart*

The object in building a very high smeltery stack is to carry obnoxious gases far above the surrounding ground and is not to obtain draft. Then if the gases do settle to the ground, they will be greatly diluted and their deleterious action either greatly reduced or entirely eliminated. In this connection it might be mentioned that to get the best results in diffusing the gases the velocity should be high on leaving the stack. In other words, for a given quantity of gas the inside diameter at the top should not be made too liberal.

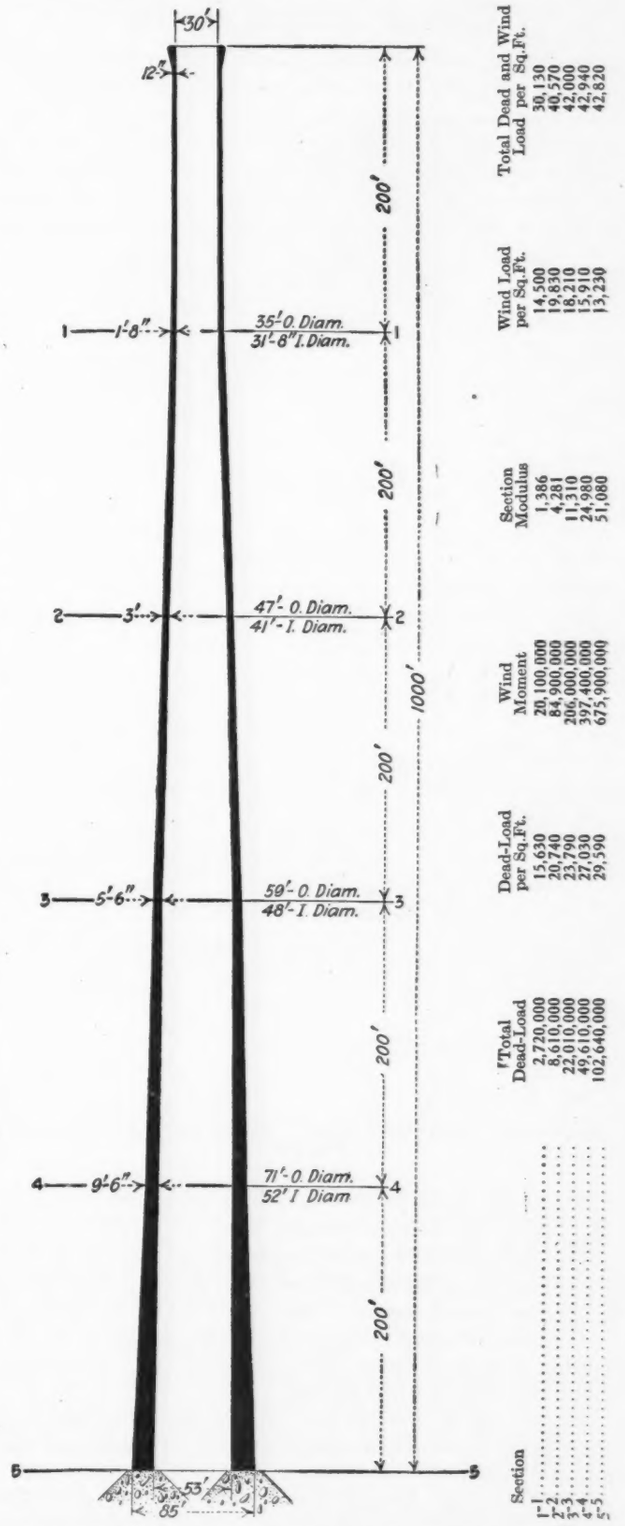
The highest stack in existence today is at Great Falls, Mont., and the height is 506 ft. It might be thought that there never will be need of building a stack higher than this. However, if the cost were not too great, it is quite likely that a stack much higher than 500 ft. would improve smoke conditions materially in some localities. It was in order to get an idea of the quantities of materials necessary to build a 1000-ft. stack that the accompanying design was made. The design is only preliminary; it will be noted that the stack was only divided into five sections. Nevertheless the cubic feet of brickwork should not vary by more than a small percentage from that of the final design. The following assumptions were made: Stack to have no lining; flue openings to be in the foundations instead of the stack proper; stack to be built of hard-burned perforated blocks; maximum compression for combined dead and wind loads to be 43,000 lb. per sq.ft. of walls; this is a little less than 300 lb. per square inch; wind load 30 lb. per sq.ft of projected area; temperature of gases, 300° F.; weight of brickwork, 100 lb. per cu.ft.

The stack has a capacity of 1,412,000 cu.ft. of gas per minute assuming a velocity of 2000 ft. per min. at the top of the stack and should develop a theoretical draft of 3.5 in. of water. Friction loss would be about 0.84 in. of water, leaving a net available draft of 2.66 in. of water.

The accompanying table gives the results of the calculations for dead and wind loads. The total dead-loads and wind moments are for all of the stack above any particular section.

It will be seen from the sketch that though the diameter of the base is very great, the stack does not look at all "squatty" which is because of its great height. As a matter of fact it would probably have a more needle-like appearance than any of the stacks now standing.

The total contents of the brickwork in the stack is 1,026,400 cu.ft. Assuming the cost per unit for brickwork to be 10% higher than a moderately high stack the cost for the stack would be $698,000. This is exclusive of the foundation. The foundation would have to be designed to suit the ground on which it was built. Assuming the ground to be cemented gravel good for 12,000 lb. per sq.ft. the foundation would be about 150 ft. in diameter, would contain 14,000 yards of concrete and 90 tons of reinforcing steel. Cost of foundation estimated at $94,000. Total cost of stack and foundation estimated $792,000. This is such a staggering amount that it is doubtful if the benefits from the high stack would warrant such an expenditure.



PROPOSED 1000-FT. STACK FOR SMELTERY SMOKE

*Salt Lake City, Utah.

Details of Practical Mining

Cost of Leaking Steam*

To determine the cost of leaking steam with any degree of accuracy at least four factors must be known: (1) The number of pounds of steam evaporated by one pound of coal (the greater this factor the less the cost of leaky pipes, other conditions being the same); (2) the total area of leakage; (3) the absolute steam pressure, which is equal to the gage pressure plus atmospheric

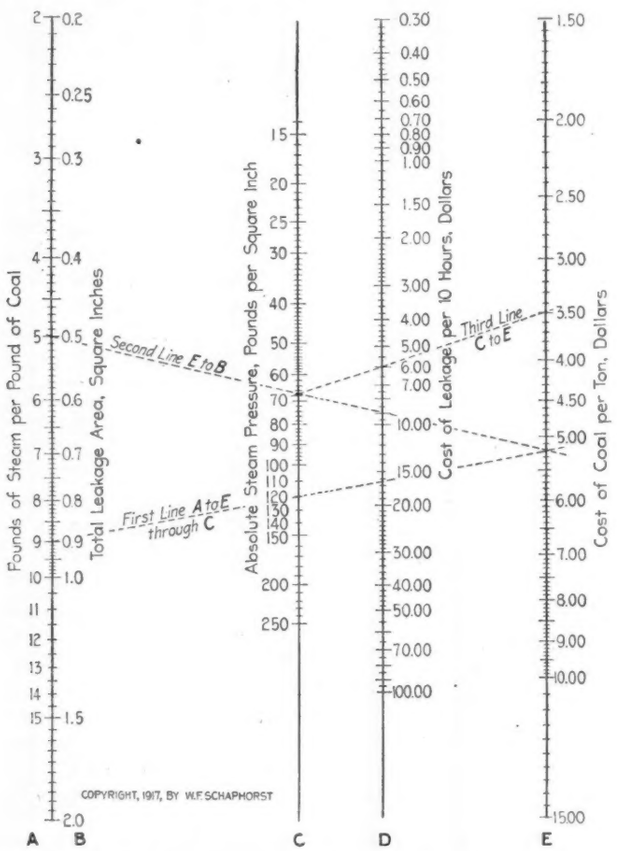

Pounds of Steam per Pound of Coal
Total Leakage Area, Square Inches
Absolute Steam Pressure, Pounds per Square Inch
Cost of Leakage, per 10 Hours, Dollars
Cost of Coal per Ton, Dollars
Second Line E to B
First Line A to E through C
Third Line C to E
COPYRIGHT, 1917, BY W.F. SCHAPHORST
A
B
C
D
E

DIAGRAM FOR DETERMINING THE COST OF LEAKING STEAM

pressure (at sea level this is usually gage pressure, plus 14.7); (4) the cost of coal per ton.

For example, how much money is lost every 10 hr. under the following conditions? Nine pounds of steam is generated by each pound of coal; the total area of leakage is ½ sq.in.; the gage pressure is 105 lb. per sq.in. (making the absolute pressure approximately 120 lb.); and the cost of the coal is $3.50 per ton.

Simply lay a straight-edge across the accompanying chart three times as indicated by the dotted lines, and the problem is solved. Run the first line from the 9 (column *A*) through the 120 (column *C*) and locate the intersection in column *E*. Run the second line from that point of intersection to the 0.5 (column *B*) and locate the intersection in column *C*. From that point of intersection run the third and last line to the $3.50 (column *E*), and the answer is found at the intersection with column *D*. The answer is $6 loss per 10 hr.

In case it is found that the total leakage area is less than shown in column *B*, the chart may be used just as easily by merely shifting decimal points. For example, if in the problem given the leakage area had been 0.05 instead of 0.5 sq.in. The answer would be 60c. instead of $6 per 10-hr. day.

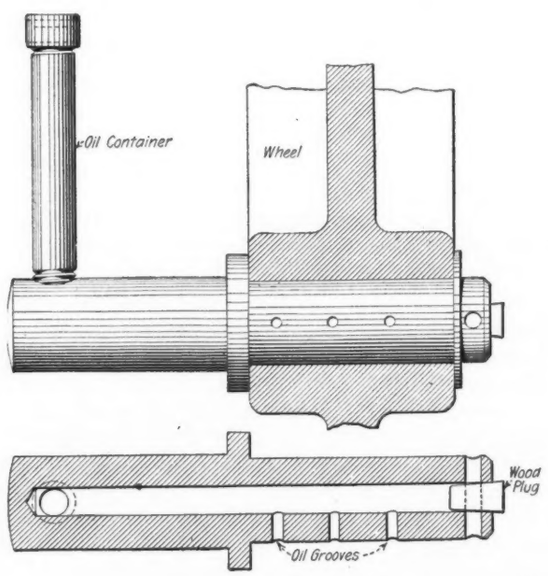
When using the chart the steps must follow in the order shown and described: First line, *A* to *E* through *C*; second line, *E* to *B*; third line, *C* to *E*. The range of the chart is great enough to handle any ordinary problem.

*Copyright, 1917, by W. F. Schaphorst, mechanical engineer, Woolworth Building, New York.

A Skip Axle Which Keeps Oiled

By James E. Harding*

Skip axles on which the wheels turn, generally wear out quickly. They cannot be kept oiled because grit gets into the bearings, removes the grease and cuts the metal out. At the Dairy Farm mine, California, 2½-ton skips running on a 60-deg. incline handle ore that is mostly pyrite. Formerly the axles used were of the regular wagon



A SELF-OILING SKIP AXLE

type with pressure grease cups in the wheels, which were bronze-bushed. This type lasted from three weeks to a month. Then they had to be replaced with new axles and all the wheels had to have new bronze bushings.

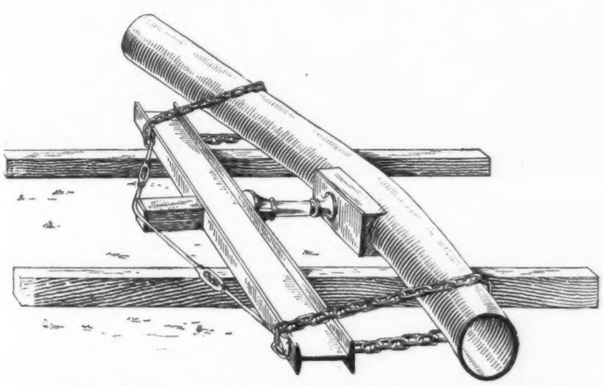
*Care of American Smelting and Refining Co., Caldera, Atacama, Chile.

Finally F. M. Simpson, the master mechanic, designed the axles shown in the accompanying illustration. A 5/8-in. hole was bored directly into the center on the end of the axle to a depth of 11 in. The outer end of this hole was filled with a wooden plug extending in beyond the clinchpin hole. At the inside end of the hole another was bored, from the side of the axle, at right angles to the first and connecting with it. This latter was threaded to take a section of 3/4-in. pipe, 6 in. long. The other end of the pipe section was covered with a regular pipe cap carrying a vent hole 1/16 in. diam. Then three 3/16-in. holes were drilled from the bearing part of the axle, through to the center hole, at right angles to the hole in which the 3/4-in. pipe is set. Lastly, the clinchpin hole was drilled through the wooden plug, making it impossible for oil to escape except between the two parts of the bearing.

When affixed to the skip, the pipe lies along the outside of the bottom of the skip and is well protected. In this way the delivery of oil occurs at the top of the bearing. The pipe is filled with zinc shavings to retard the flow of the oil. All pipes are filled with oil twice each shift. A set of these axles has been in constant service for over six months and shows no appreciable wear.

Labor-Saving Pipe-Bending Machine

A labor-saving device is used by the Philadelphia Suburban Gas and Electric Co., Chester, Penn., for the cold bending of 8-in. pipe, which appeals to mining men who have long pipe lines to lay. The machine is described by Charles Wilde in a paper presented at the October meeting of the American Gas Institute and in *Engineering and Contracting,* Jan. 10, 1917. The arrangement consists of a 10-in. I-beam, 10 ft. long, braced with 1 1/4-in. tie-rod, two 3/4-in. chains 8 ft. long and an ordinary 20-ton screw jack and block. To operate, all that is necessary is to link the chains around the pipe and I-beam by means of a slip link, place the jack and



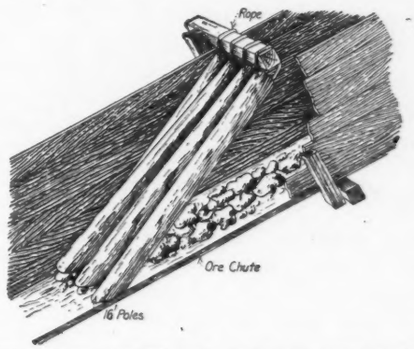
AN EASILY MADE PIPE-BENDING APPARATUS

pipe block in position between the pipe and the beam, and then by the force of the jack make the bend. If the bend required is only a slight one, it may be made without any shift of the machine. If it is of any considerable extent, the machine should be shifted one way or the other, bending the pipe a few degrees until the required bend is made.

With this machine four men can make a bend in an 8-in. pipe, depending of course upon the radius and degree of the bend required, in from 1/2 to 2 1/2 hr., or a labor cost of from 50c. to $2.50 per bend.

.Pole Buffer in Ore Chute

In the accompanying illustration is shown a device for retarding ore or rock rolling down a steeply inclined chute. A number of poles, 8 to 10 in. diameter, are suspended in parallel groups from the tie-pieces of the chute, as shown, the lower ends resting on the bottom of the chute. The number of poles and the distance between the groups vary according to the steepness of the chute and the character of the ore. Ordinarily, one pole to each foot in width of chute will suffice. If the ore is coarse and dry, the groups of poles will have to be



REDUCING THE SPEED OF ORE IN THE CHUTE BY POLE BUFFERS

so spaced that the lower ends of one group will be about vertically under the upper ends of the next lower group. For finer ore or material that is wet or sticky, a wider spacing will be sufficient. If the ore changes from a free-rolling to a slower-moving material, it is a simple matter to elevate the lower ends of one or two poles of each group by tying them to the next lower chute-tie, thus permitting a less interrupted passage.

Rope Capacity of Drums

The rule used by A. Leschen & Sons Rope Co. for computing the rope capacity of any size of drum, is as follows: Add the depth of flange in inches to the diameter of the drum, multiply this result by the out-and-out width of the drum and by the depth of flange. This product is then multiplied by the factor in the accompanying table corresponding to the size of the rope used.

FACTORS FOR DRUM CAPACITY

1/4 in. 4.16	7/8 in. 0.342	1 3/4 in. 0.085
3/8 in. 1.86	1 in. 0.262	1 7/8 in. 0.074
7/16 in. 1.37	1 1/8 in. 0.207	2 in. 0.066
1/2 in. 1.05	1 1/4 in. 0.167	2 1/8 in. 0.058
9/16 in. 0.828	1 3/8 in. 0.138	2 1/4 in. 0.052
5/8 in. 0.672	1 1/2 in. 0.116	2 3/4 in. 0.046
3/4 in. 0.465	1 5/8 in. 0.099	2 1/2 in. 0.042

This rule applies of course to a drum on which the rope is to be wound in successive layers up to the full height of the flange. As published in the "Handbook of Mining Details," p. 184, the rule is incomplete at it omits to multiply by the factor "depth of flange."

Cow Bell on Cage

In metal mines in which it is not practicable to employ a station tender at each level, it is suggested in the Proceedings of the National Safety Congress to use a cow bell underneath each cage. This will give warning of the approach of the cage and will remove the necessity for a miner to put his head out into the hoisting compartment to see where the cage is.

Hidden Creek Mine and Smeltery

By Donald G. Campbell*

SYNOPSIS—An account of the Granby Consolidated's copper operations at Anyox in northwestern British Columbia. From 2000 to 2500 tons of ore, yielding about 35 lb. of copper and 35c. per ton in gold and silver, is mined and smelted daily.

The Hidden Creek copper mine and the Anyox smeltery of the Granby Consolidated Mining, Smelting and Power Co. lie on the north shore of Granby Bay, a secluded body of water opening on the upper end of Observatory Inlet, in northwestern British Columbia.

Observatory Inlet is one of the typical long, narrow fiords which cut deeply into the Coast Range of British Columbia and help to compensate for the lack of rail transportation through that rugged country.

The town of Anyox has good freight and passenger service by steamers both from Vancouver, nearly 400 mi. to the south, and from Prince Rupert, on the Skeena River, the terminal point of the Grand Trunk Pacific, about 100 mi. to the south. This route is of great scenic beauty, being for the greater part a narrow channel lying between densely wooden islands and the mainland. The mountain ranges usually slope up steeply from the shore line, and on many of the peaks glacial ice lingers the year round, nearly down to the water. A large number of salmon canneries are scattered at favorable spots along the coast; and during the salmon run the many fishing grounds are thickly dotted with the gasoline boats of the Japanese and Indian fishermen, working untiringly to make the most of their short summer harvest.

Coming into Anyox, a busy harbor scene is usually in evidence. A modern dock, 50x500 ft. long, is provided with three traveling bunkers, cranes and other facilities for handling ore and freight. It is in constant use and in fact is usually crowded with ore, lime and coal barges two or three deep waiting their turn to be worked, so that the occasional passenger boat seldom has more than room enough to shove her nose up the dock to land the Anyox visitors.

Back of the dock a modern concrete three-story building, 117x60 ft., serves as store, commissary, etc. Beyond this a planked road leads past a modern and comfortable hotel to the town and smeltery, which lie close at hand on the north and west. In the background rise the Burniston Mountains to a height of 5700 ft., separating Observatory Inlet from Portland Canal to the north.

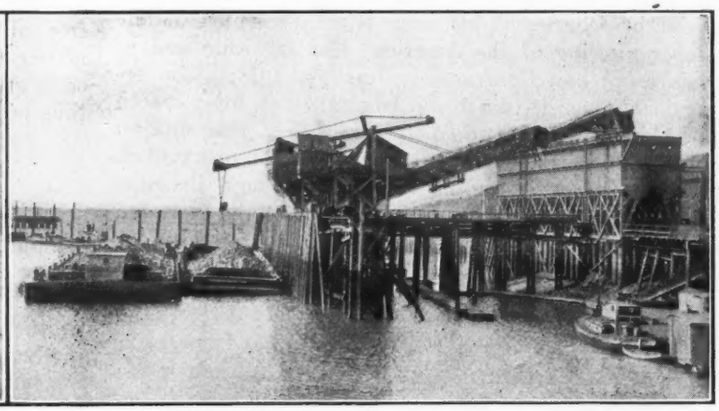
The Hidden Creek Copper Mine

A walk of about two miles to the north along the nearly level haulage track leads to the mouth of the main haulage tunnel, or 150-ft. level of the mine. The elevations are referenced to sea level and not to the topmost workings or to the outcrop, as is usually the case.

The Hidden Creek property was first located in 1901 by McMillan, Rudge and Flewin, of Port Simpson. It was bonded to the Daly interests, but after Daly's death was allowed to revert. In 1905 interests associated with the original Britannia Copper Syndicate bonded it and did some development work. Finally, in 1908 M. K. Rodgers bought it on behalf of himself and associates, continued the development and two years later sold it to the present owners at a reported price of $500,000.

Henceforward development was actively pursued, and by 1914 there had been 21,400 ft. of drifts and raises driven as well as a large amount of diamond-drill work.

ORE STEAMER EN ROUTE TO ANYOX, B. C.



UNLOADING BARGES OF LIMEROCK AT ANYOX

As a result of this work two principal orebodies have been developed and two others discovered and partly developed. Together the two former bodies have ore estimated, in the company's annual report for 1915, at 9,205,837 tons averaging 2.17% and 8,628,000 tons of 0.63%, or a total of 17,833,837 tons averaging 1.43%. To this should be added over 900,000 tons of similar grade in the "Bonanza,"—a near-by property now belonging to the company.

The two orebodies of the Hidden Creek group are opened by levels at 150, 230, 385, 530, 630, 700 and 800 ft. above sea level. The bodies are both elliptical in section, No. 1 being 1300 ft. long striking north and south and dipping 65° to the west. No. 2 strikes northwest, is nearly as long as the first and dips 45° to the northeast. The geology has been described[1] as follows:

The rock formation in which the orebodies occur may be best described as an argillaceous schist; it has been subjected

*Mining and metallurgical engineer, Campbell-Wells Co., 114 James St., Seattle, Wash.

[1]"Report of Minister of Mines for British Columbia," 1911.

to very considerable alteration, and in some places the fissile structure of the argillaceous bands has disapeared and the rock appears to be massive. This rock formation can be traced for several miles along the shore of the inlet to the adjacent islands and extends nearly to the summit of the mountains to the west of the property, where the Coast granites are found. The orebodies are at some places cut by intrusive dikes, but these dikes have no influence on the nature of the ore nor on its commercial value.

Mining operations consist of "glory-holing" from the surface down to about the 700-ft. level, and shrinkage-stoping on an incline to the full width of the orebody, leaving pillars as demanded by the ground. The ground is fairly hard and stands well. Practically no timber is used. The chutes from the glory hole and the various stopes on each orebody converge to a single pair of chutes on the 380 level, where the ore is discharged into mine cars. These are hauled in trains of 10 or 12 by electric locomotives and dump automatically into outside bins on the hillside above the crusher. Passing through the crusher, the ore discharges through a rock chute into the 150 level below, where it is finally loaded into 20-ton steel hopper cars and hauled to the smeltery. All heavy-duty chutes are lined with steel plates and are provided with iron finger gates operated by compressed air, instead of the usual arc type. Underground haulage is by 3.7-ton side-dump steel cars, pulled by 6-ton electric locomotives; a track of 2-ft. gage, laid with 30-lb. rails, is used in all tunnels and drifts. All haulageways are electric-lighted. Carbide lighting is used entirely by the men, the carbide being furnished by the company and the men providing their own lamps.

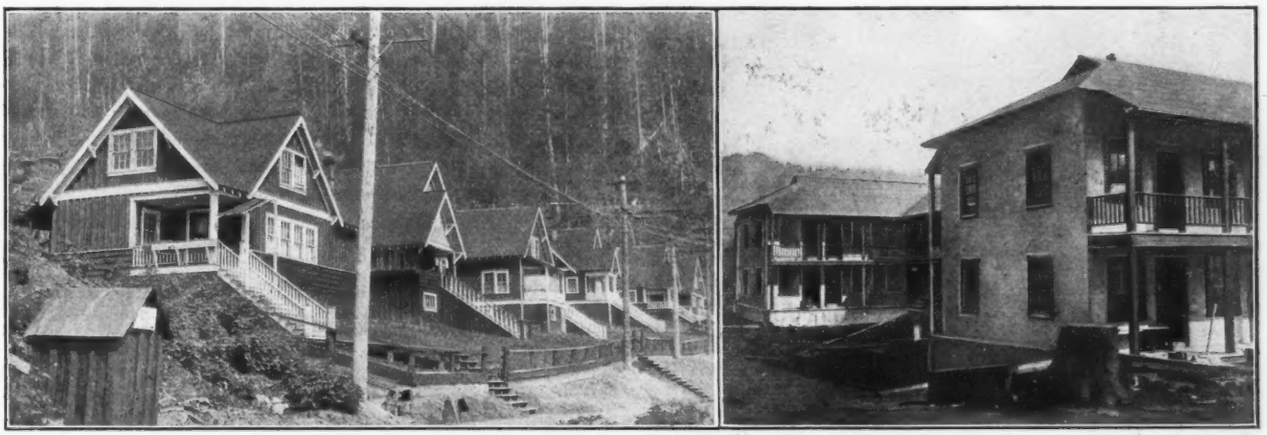
The 530 level is the main entry for men and supplies. From it manways and skips lead to the various stopes above and communicate with the glory holes. An underground blacksmith shop, containing a Leyner drill sharpener and Case oil-fired steel forge has been fitted up in a central location on this level.

The 380 is the main development level, and most of the necessary development work on the Nos. 1 and 2 orebodies has already been done from this level. Later it is planned to extend the 150 level to tap the lower portions of the various orebodies.

The average daily output at present is 2000 to 2500 tons, proportioned as nearly as feasible between the siliceous No. 2 ore and the heavier sulphides in No. 1 orebody. Thus, at this rate of exploitation the property will have a life of 25 to 30 years. During 1915 the amount of ore smelted was 477,435 tons, yielding 16,597,737 lb. copper, 197,704 oz. silver, and 3581 oz. gold, or an average yield of about 34.7 lb. of copper and 35c. in gold and silver per ton.

Mining costs for 1915 were given as $1.03 per ton, loaded in cars for the smeltery. This includes the handling of 29,000 tons of waste and a development charge of 10c. per ton. A 50c. bonus was also paid the men, which made a charge of 7c. per ton on the ore. With the completion of various improvements, and under normal conditions, it is expected that this cost will be reduced to 81c. per ton. As in other copper camps of the country, labor is today exceedingly prosperous, the lowest wages being $4 a day, including the $1 bonus due to the high price of copper. Miners and smeltermen get $4.50 to $6 a day.

At the smelting plant in Anyox, every fifth or tenth car of ore is discharged into sample bins, to be sampled, and the remainder goes to the regular storage bins. From these, Anaconda-type charge cars receive the required mixture and deliver it to the blast furnaces. These are four in number, each 54x360 in.; blast is supplied at about 50-oz. pressure through 5-in. tuyeres placed at 11-in. centers. Semipyritic smelting is employed, the coke varying from 5 to 10% of the charge. The charge cars do not discharge directly into the furnaces, but into a hopper on the charge floor. Plows, or scrapers, operated by compressed air force the charge over a lip plate which overhangs the side of the furnace by about 9 in. The speed of the plows may be controlled to place the charge more to the middle of the furnace or to the wall, as may be necessary. This results in an even feed, gives hot edges and prevents crusts and bridges, it is claimed.



FRAME COTTAGES AND CONCRETE DORMITORIES AT ANYOX, B. C.

The slag from the blast furnaces is granulated and is being flushed out to reclaim a considerable area of tide land lying under shallow water close to the smeltery. Because of the heavy matte fall, a low-grade and corrossive matte is produced, usually running from 8 to 12% copper. This at present is run into beds, allowed to cool, blasted lightly, and scraped into railroad cars with drag scrapers, to be elevated and reconcentrated to a grade of 25 to 30% copper.

The converter plant contains three stands of 12-ft. Great Falls type converters. The blister copper is cast into molds, holding 325 to 350 lb., in a straight-line casting machine. It is shipped mainly to the Nichols Copper Co. for refining. Flues from the converters and

downtakes from the blast furnaces lead to a dust chamber. From this a main flue leads to the reinforced-concrete stack, which is 22 ft. in diameter by 150 ft. high, the top standing 300 ft. above the furnaces.

Coke is brought to the smeltery in large wooden boats or barges from Comox, on Vancouver Island. Custom ore and some from the mines on Prince of Wales Island belonging to the Granby company are also brought here for treatment. Lime for the blast furnaces and silica for the converters are quarried a few miles away and transported in ordinary flat barges. From the bunkers on the dock the ore and coke are discharged into 15- to 20-ton hopper-bottomed steel cars, to be taken to the storage bins above the blast furnaces. The track is 3-ft. gage, laid with 56-lb. rails, and haulage is by Baldwin-Westinghouse 40-ton electric locomotives. The distance to the blast furnaces from the dock is about 10,000 ft., including a switchback, and the maximum grade is about 2½%.

The power for the smeltery and mine is generated in a hydro-electric plant just below the smelting plant. Water from a reservoir on Falls Creek is conveyed in a 6-ft. wood-stave pipe to a point directly above the generating station, then carried down in steel pipes, a head of about 380 ft. being secured. The power equipment consists of two generators, 938 kv.-a.; two motor-generator sets of 300 kw.; three Connersville blowers,

CHANGE HOUSE AT HIDDEN CREEK MINE

direct-connected to Pelton wheels, supplying 48,000 cu.ft. of free air per minute at 3-lb. pressure; a Nordberg blowing engine, having a capacity of 21,000 cu.ft. of free air per minute at 16-lb. pressure; another Nordberg two-stage compressor, with a capacity of 4000 cu.ft., supplies air at a pressure of 100 lb. The power was shut off for a considerable time during the cold weather last year on account of ice; to guard against such failures in the future an auxiliary steam plant has been constructed, to be operated with crude oil as fuel.

A foundry is in constant use at the plant, in connection with a thoroughly equipped machine shop containing modern machine tools of every description, including millers, turret lathes and all facilities for rapid work. Practically all repair parts are made here for both the mine and smeltery.

The Anyox town site is on the comparatively flat base of an irregular hillside, heavily wooded; much of it is a soft muskeg, with occasional knobs of granite projecting through. Hence a great deal of laborious clearing has been necessary to make conditions as presentable as they are now. A regular street system has been laid out in the town, and all the roads have been planked. Upward of a hundred cottages of the bungalow type, containing three, five and seven rooms, have been built by the company for its married employees. These have all been neatly painted, and in many cases lawns and other evidences of home-making add much to their attractiveness. A good sewerage system and water works, with a pressure of 60 lb., have been provided, and electric lighting is installed in all the cottages and has been adequately supplied along the streets. For single men a neat type of concrete dormitory has been supplied. Several of these are now built; they are of two stories, have cement floors and are plastered inside; wide verandas on both floors add materially to their appearance. Inside individual steel cots, two in a room, are provided. Large wash and locker rooms and a reading and billiard room make much more comfortable conditions than are usually found in isolated camps in the North. A large recreation hall is centrally located, and hospital, school and church show that good provision has been made for the needs of community life. A frequent boat service, winter and summer, keeps the community well supplied with fresh news and provisions, and both wire and wireless communication overcomes the isolation of its position on the map.

As in the case of most of the important mining and smelting companies of the present day, a great deal of attention is being paid to safety. At the mine an active "safety-first" squad is under the leadership of the mine foreman, Mr. Swanson. This reports at regular meetings on conditions existing throughout the mine workings, and suggests all improvements or precautions that seem necessar" Along with this a first-aid course is given.

Methods of Testing Natural Gas for Gasoline Content*

Natural gas to be treated by compression and condensation methods may be tested for its gasoline content by determining the specific gravity of the gas and the percentage of absorption in oil. The quantity of gasoline that may be obtained from natural gas ranging in specific gravity from 0.64 to 1.46 varies from zero to 5 gal. per 1000 cu.ft. of gas tested. The yield corresponding to the percentage of the gas absorbed in oil varies from zero for an absorption of 16% to 5 gal. for an absorption of 86%.

So called "dry gas" can be tested for treatment by the absorption process, a method that is a duplicate on a small scale of the large-scale practice. The method consists in absorbing the gasoline in "mineral seal oil" by passing a measured amount of the gas through the oil in a portable absorber and then distilling the absorbed gasoline out of the oil.

Another method that is essentially a laboratory method consists in freezing the gasoline out of the natural gas at a temperature of about—115° C. The flow of gas from a well may be determined by the use of a pitot tube or an orifice meter; the flows of less than 15,000 ft. in 24 hours may be measured directly by domestic meters.

*Excerpt from "Methods of Testing Natural Gas for Gasoline Content." Bureau of Mines, Technical Paper 87. Washington, D. C.

Conditions in Belgium

At a dinner tendered to Herbert C. Hoover by the Rocky Mountain Club, Jan. 29, Mr. Hoover, according to the New York *Herald* of Jan. 30, 1917, endeavored to make the American people comprehend the conditions in Belgium and the necessity for continued and greater assistance as follows:

"A difficulty I have is to visualize to men who have not been in Europe since the war began the actual situation which exists in an occupied territory. Endeavor to imagine New York and about five adjoining counties occupied by an enemy army, blockaded from without and surrounded within by an army of steel, the normal flow of food stopped; you would awaken within 36 hr. to find your markets empty and your bakeries stopped.

"Add to this that your railroads would be taken over for military purposes; that your telephones and telegraphs would be suppressed; that your newspapers would be closed up; that every form of communication and intellectual life would cease instantly; that you could not move outside your own wards and your own villages; that you could not assemble except by special permission; that every street corner and every crossroads would be occupied by a sentry; that the normal feeling of security which every man has is lost; that he has not even an appeal to justice—all this is gone. He is submerged in the fact that he is subject to only an army—even then you have an inadequate picture because it is almost impossible to convey to you the psychology of a people under such a stress.

"The feeling that the food supply of the community, the food supply of an individual, may cease at any moment, that your women and children are in imminent jeopardy, and the feeling that disturbance only means bloodshed in the streets, that there is no possible salvation nor any solution, all this in a population ashiver with rumors, goes beyond the ability to describe.

Their One Salvation

"This has been the situation of Belgium and northern France, with 10,000,000 persons, for nearly two years, with one exception, and that exception is the Commission for Relief. The Commission for Relief has not only been the salvation of their food supply, but has been their protection and despair."

Mr. Hoover here explained that both Germany and the Allies regarded the destitution of Belgium as being the affair of the other forces, although each allowed the work of the commission, the Allied governments even donating $14,000,000 monthly to feed the desitute people of the country.

"Up until the first of January," he said, "we had spent $250,000,000, and we are now issuing over 2,500,000 loaves of bread every month; we have divided up 20,000,000 to 30,000,000 lb. of fats and distributed 5,000,000 tins of condensed milk.

"The Belgians have come to look upon Americans as their sole saviors, to look upon the American flag as the flag which is fighting to protect them. Within six weeks' time I have visited in the slums of Brussels where 1500 children were sitting down to their one meal, and I heard those youngsters warbling the first stanza of 'The Star Spangled Banner.' Now, knowing that that food supply was not American I could feel nothing but shame. Europe is taking stock of this Relief Commission.

"We started off with high promises as to American support and American ideals, we have rested on the belief that we had the undoubted backing of the American people in our endeavor to keep this gate open. Oftentimes we have had to defend the portals of the enclosure, and we have always used as our last and final weapon that interference with the Belgian Relief would offend the sensibilities of the American people more deeply than anything that has happened in this war. And yet Belgian relief is being paid for with foreign money. But of more importance than this purely moral question is the fact that our finances are in great jeopardy. As the time goes on the situation becomes more desperate in Europe, our necessities grow greater, it is growing more and more difficult to see our way through.

"Today our budget calls for about $18,000,000 to $19,000,000 a month, if we are not to reduce the food supply of these people. We are receiving $14,000,000 a month from the allied governments; there is no hope of any increase in that and there is always the possibility that at some stage we may lose it altogether. In any event, we are from $3,000,000 to $5,000,000 a month short. We have to raise this money by public charity and the few American measures which we are able to secure, and we thought that perhaps the American people would take off our shoulders the burden of those 1,250,000 children. This feeling is crushing to our national pride; it undermines our ability to defend these people, and what is more, it is frought with the utmost suffering, at a point which should touch the heart of every American deepest.

This matter is one of more importance even than the feeding of 1,250,000 children, as large as that may be. This relief has come to be America's greatest exhibit in Europe. We are undertaking to do it on the faith of the American people; we are undertaking to do it, knowing that they will do it in the American way; we want to give a demonstration here of that great humanity which we know runs through our people, because we know of the character of the people that make up this republic. If we succeed it will be because we have received the support of the American people instead of being forgotten."

The Field of the Electric Furnace

Harry Etchells, one of the designers of the Greaves-Etchells electric steel furnace, in a recent lecture before the Sheffield Society of Engineers and Metallurgists, noted in *Iron Age,* Feb. 1, 1917, said that when dealing with the cost of melting, even at the present comparatively high prices caused by war conditions, the electric furnace had proved a good investment to many users and an immense boon in the economy of steel production and utilization of scrap. "The war has shown us," he said, "how to make ourselves independent of Swedish bessemer imports and to convert into valuable steel the accumulation of nickel and chrome steel scrap. In spite of difficulties of manipulation, which still remain to be overcome, the electric furnace has a part of its own to play, and has come to stay." Prof. J. O. Arnold, the president, observed that if the electric furnace had come to stay, there would have to be cheaper current; that this is one of the greatest obstacles to the development of the electric furnace in Sheffield, which would have to be got over in some way.

Chronology of Mining for Month of January, 1917

Jan. 1—Reorganized "Ohio Copper Co. of Utah" resumed operation of Ohio mine in Bingham Cañon, on company account.

Jan. 3—Three men killed in Pittsburgh-Idaho mine at Gilmore, Idaho, by explosion on 400 level; 10 others, temporarily entombed, rescued on following day.

Jan. 4—United Eastern's 200-ton mill in the Oatman gold camp in Arizona began operation.

Jan. 9—Reduced assessment on Cuyuna Range prospects ordered by Judge McClenaghan in George H. Crosby's case against Minnesota state tax commission.

Jan. 10—Announcement of Goldfield Consolidated's policy to resume leasing at its Nevada mines.

Jan. 14—Mexican decree, embodying forfeiture of idle mining properties, extended to Feb. 14; further postponement asked by U. S. Government.

Jan. 15—Frisco mill, near Gem, Idaho, deeded to Tamarack & Custer Consolidated Mining Co. by Federal Mining and Smelting Co.—Dissolution of Pilot-Butte Mining Co. ordered by court, assets having been purchased by Anaconda.

Jan. 16—Labor strike at New Cornelia Copper Co's. new leaching plant at Ajo, Ariz., practically ended by structural-steel workers returning to work, repudiating jurisdiction of Western Federation of Miners.

Jan. 20—First section of Consolidated Coppermines Co.'s 500-ton flotation mill started at Kimberly, Nev.—Machinery "turned over" at new electrolytic zinc plant of Judge Mining and Smelting Co., near Park City, Utah.

Jan. 23—Withdrawal begun of American "punitive expedition" from Mexico.—Agreement reached whereby Bullwhacker and Butte-Duluth copper properties in Butte, Mont., will be jointly worked by Mines Operating Co.

Jan. 24—End of two-weeks' strike at Perth Amboy plant of American Smelting and Refining Co.

Jan. 29—Announcement of listing of Calumet & Arizona Mining Co.'s stock on New York Stock Exchange.

Jan. 30—Art. 33 of new Mexican constitution, requiring foreigners to renounce nationality and treaty rights before acquiring property, withdrawn for reconsideration by the Constitutional Assembly in Queretaro.

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British Iron and Steel Exports

The British Government's efforts to restrict iron and steel exports are meeting with success (according to a report in *Iron Age,* Feb. 1, 1917). The December exports, excluding iron ore and including scrap, were only 158,609 gross tons, the lowest for any month in 1916. The decline was regular in the last four or five months of the year, the high mark having been reached in May with 395,750 tons. The December exports were the lowest for any month in the last three years.

Taking 1916 as a whole the exports exceeded those for 1915 by only a little more than 100,000 tons—3,357,829 tons against 3,248,046 tons. In 1913 they were about 5,000,000 tons, a year of exceptional export trade. The average value per ton of exports last year was £17 4s. as compared with £12 12s. in 1915 and £10 14s. in 1914.

The pig-iron exports in 1916 were exceedingly large, amounting to 790,065 tons, of which France took over 75%. The average value per ton was £5 18s. as compared with £2 18s. 6d. in 1914 and £3 7s. 6d. in 1913. As to ferromanganese, the statistics show that the United States was credited with 81,600 tons, or over 60% of the total exported, the remainder going almost entirely to the Allied countries. The average value per ton of exported ferroalloys advanced rapidly, having been £21 15s. as against £8 10s. in 1914.

In rails the shrinkage in exports was decided, the total for 1916 having been only 50,275 tons, as compared with 242,267 tons in 1915 and over 500,000 tons in 1913. Steel bars showed a phenomenal increase, the total for 1916 having been 617,159 tons (France taking 519,888 tons) against 489,191 tons in 1915 and about 251,000 tons in 1913.

Imports of iron and steel, excluding iron ore and including scrap, in 1916, were only 872,890 tons as against 1,290,603 tons in 1915. The valuation, however, was considerably higher. Last year 6,900,000 tons of iron ore were imported or about 700,000 tons more than the imports of 1915, which is well up to the average of pre-war years. In 1913 the iron-ore imports were 7,442,000 tons. Imports of pig iron and finished iron and steel continue to decrease. Last year they were only 775,000 tons, the lowest figure for 16 years. In 1915 imports of American billets were 350,000 tons; in 1916 they were 120,000 tons. "So far, however, as manufactured and finished forms are concerned the quantities reaching these shores are still large," says the London *Iron and Coal Trades Review,* "a considerable tonnage of wire rods, wire nails, tubes and fittings, etc., having been imported, almost entirely from the United States."

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Steel Manufacture in South China

A critical situation has been reached in the production of pig iron and the manufacture of steel and general steel products in South China, according to a report from G. E. Anderson, consul general at Hongkong, published by the Department of Commerce at Washington, and the indications are that in the next few months there will be some important developments. Negotiations have been undertaken by various Japanese interests looking toward the acquiring of certain mining rights in South China and for the inauguration of a steel-making plant in or near Hongkong for serving the South China trade, especially in the line of rolled iron and steel not exceeding 5 in. cross dimensions and steel plates not exceeding ½ in. in thickness, for which there is a strong demand in this market and which can be manufactured in a plant of comparatively small cost.

The Hongkong Steel Foundry Co., Ltd., was organized five years ago for the purpose of making steel ingots or molds by a secret process from scrap steel or, if the demand justified, from crude iron ore or pig iron. The company has slowly developed its business until it is now operating two double sets of four furnaces each, but continues to use only scrap steel and pig. Its object, as indicated in its report, has been the development of a steel-manufacturing plant to handle ore from deposits in South China. With a view to such development the company has an option on several hundred acres in the Waichow district of Kwangtung province and has plans for a complete plant, including railway and other transportation service to and from Hongkong and Canton. Outside capital is needed, and it seems likely that it will come either from Japan or from the United States.

McKinley-Darragh-Savage Flotation Plant, Cobalt, Ont.*

To show the possibilities of flotation on silver ores, a brief description is given of the McKinley-Darragh plant, at Cobalt. Some of the mills in this district, notably the Nipissing, are handling their ores by cyanidation, and in other mills by a combination of concentration and cyanide. Generally speaking, it may be said that flotation will give from 1 to 1½ oz. better extraction than cyanidation will, using the same degree of comminution. The principal problem involved in a wider application of flotation to this district is the disposal of the concentrates. The present smelting and freight charges on a 300-oz. concentrate varies from $20 to $25 per ton. A great many different methods have been tried for a local treatment for these concentrates. The most encouraging results have been obtained by a chloridizing roast with the Holt-Dern roasting process. A movement is now on foot among some of the operators to install an experimental plant of this description. It is confidently expected that this will be the ultimate solution for the local treatment of Cobalt flotation and other concentrates, effecting a saving of $10, and possibly of $15, per ton from their treatment charges over smelting.

The feed to the flotation plant consists of slimes resulting from mining operations and primary crushing, which are separated in the jigging plant, and mill slimes resulting from crushing in stamps and one pebble mill. The mill treats 200 tons per day, approximately 50% of which reaches and is treated in the flotation plant; 93% of the feed to the flotation plant is finer than 200 mesh. The chief economic minerals recovered by flotation are argentite, proustite, pyrargyrite and metallic silver.

The plant consists of two triple-length Callow roughers, operating in parallel and two standard-length Callow cleaners, operating in series, the tailing from cleaner No. 1 being recleaned in cleaner No. 2. Table 1 gives a summary of typical results.

TABLE 1. FLOTATION RESULTS AT THE McKINLEY-DARRAGH-SAVAGE MINES, LTD.

Month, 1916	Week	Heads	Tails	Concentrates	Extraction, %
June	2	8.04	2.01	310	75.00
	3	8.91	1.75	386	80.30
	4	7.74	1.64	363	78.80
July	1	8.65	1.90	334	78.00
	2	8.03	2.10	231	73.80
	3	5.86	1.40	172	76.10
	4	6.10	1.41	233	77.00
August	1	6.20	1.48	309	76.10
	2	6.43	1.71	289	73.40
	3	5.88	1.66	233	71.70
	4	6.71	1.53	260	73.20
September	1	7.68	2.55	349	66.80
	2	6.55	2.16	272	67.00
	3	5.30	1.35	206	74.50
	4	6.29	1.91	211	69.60
October	1	8.05	2.35	238	70.80
	2	10.05	3.74	331	62.78
	3	8.03	2.60	279	67.62
	4	8.07	3.04	177	62.30
November	1	5.64	2.13	309	62.20
	2	4.71	1.38	248	70.70
	3	4.73	1.53	204	67.60
	4	4.65	1.70	178	64.00
December	1	5.36	1.60	220	70.70
	2	6.92	1.08	217	84.50
	Average	6.78	1.909	262	71.37

Everyone who has used flotation appreciates the difficulties of taking care of the flotation concentrates, and the problems connected with their preparation for the smelters. So far, the area or tank volume necessary for a continuous settling system has never been decided on, from the fact that the area or volume required apparently varies with almost every different concentrate. The requirements for the continuous filter now in everyday use are severe, requiring a pulp of at least 50% solids and as much thicker than this as is possible. The overflow must be clear, and the accumulation of froth incident to a continuous settling plan must be taken care of. Our experience has not been satisfactory with the continuous plan, and it is for this reason that in all our recent plants, we have been installing the intermittent system. Until shown to the contrary, we think that this offers the best solution, in that with it one has complete control of the necessary density for the filters; there is no danger from losses in the overflow; the froth which accumulates during the filling of the tank is completely disposed of at each cycle of the operation, and therefore cannot accumulate.

The agitator for stirring the contents of the tank during the discharging period is copied from those used at the Goldfield Consolidated mill. It consists of arms secured to a square revolving shaft, suspended by a chain block, and passing through a square hole in the driving gear. It is simple, inexpensive, and gives no trouble whatever. The thickened pulp may be drawn off from a central bottom discharge. More recent practice is to draw off through a valve or molasses gate on the side of the tank, or better still, with a diaphragm pump.

*From a paper on "Notes on Flotation in 1916," by J. M. Callow, Salt Lake City, Utah, to be presented at the February, 1917, meeting of the American Institute of Mining Engineers at New York.

Dry Powder Fire Extinguisher

Recent analyses made for the British Government show that dry powder fire extinguishers generally contain as their main constituent bicarbonate of soda, the amount of which varies from about 46% to 56% in the different samples examined, says a writer in *Quarterly of the National Association,* reprinted in *Current Topics,* September, 1916. It is true that bicarbonate of soda, on heating, gives off a certain quantity of carbon dioxide, but, in the opinion of the investigating committee, it is doubtful if the quantity generated has a materially effective influence on the action of the powder as an extinguisher, except possibly in cases of small fires of a special nature and limited extent. Water is far more effective than dry powder, the wetting of the surrounding material preventing the spread of the fire and thus confining its area. In the application of water, experiment showed that a given volume of water applied as a jet was decidedly more effective than the same amount applied by buckets. If the whole of the carbonic acid available on heating were given off suddenly, immediately the powder is strewn on the fire, approximately 1 cu.ft. of gas would be formed for each pound of powder used. The smothering effect of this quantity of gas may be contrasted with that of the enormously larger volume of steam which would be generated by one pound of water, which gives over 25 cu.ft. of steam at atmospheric pressure.

Molybdenite in Norway—Norway is one of the chief producers of molybdenite, according to a report published in "Iron Age," Jan. 11, 1917. The two principal mines are located near Knabeheien, north of Flekkefjord. Their combined output of concentrate, averaging 75% of MoS_2, was 72 tons in 1914 and 87 tons in 1915. The success of these two companies and the demand for molybdenum has resulted in the formation of several new companies to exploit and develop surrounding claims. The two principal companies use the Elmore vacuum flotation process.

Editorials

United States Breaks with Germany

Following the receipt of the German note on Jan. 31, revoking previous agreements respecting the practices of submarines in warfare and imposing limitations upon sea traffic of neutrals as well as belligerents that no self-respecting great nation could stand, the United States of America on Feb. 3 severed diplomatic relations with Germany and stepped upon the threshold of war. If war there is to be rests solely with Germany. If she infringes any American right, there is to be war.

To this stern reality the nation awoke and as one man responded in support of the Administration which had taken grim action. No longer was there bickering or dissatisfaction. America had been threatened and defied, and America had spoken as of yore. There was no American who at noon last Saturday did not hold his head erect and feel the blood course through his veins with stronger pulse. From that time there ceased to be any hyphenated Americans. The trumpet had sounded, and there were none then but simple, loyal Americans.

The future may have its troubles in store. The German threat against Great Britain's life-line may be made effective, not only depriving Great Britain of free supplies but also depriving America of free markets. Much money may be needed. Men may be called away from peaceful pursuits for which even now there are not enough. Our already congested traffic lines may be further disturbed. All these things imply adverse economic conditions.

But on the other hand we may have an awakening that will be more than compensatory. During two decades we have seen the development of disconcerting internal conditions. There has been a growing spirit of sectionalism—South against North and East against West. There has been a growing tendency toward class legislation, setting one group of people against another, as if their interests were different. When the alarum was sounded, all such things were forgotten in the renewal of the realization that from the Atlantic to the Pacific and from the Great Lakes to the Rio Grande we are of one nation and one common interest. We awoke, moreover, to an abhorrence of shiftlessness and to an appreciation of organization and efficiency. War or no war, we cannot after this shock be just the same. The apostles of preparedness have had their justification.

That we may be able to stop short of a state of war is the prayer of all, but the belief of few. But whatever may come, America faces the future calmly, with confidence and pride.

An Anti-Fleecing Law

In proposing a remedy to protect the public from the wiles of unscrupulous promoters, Otto H. Kahn, the distinguished banker, remarked, in the course of a great speech, recently delivered: "Against the last cause (the wiles of outside promoters or unscrupulous financiers) a remedy might be found in a law which should forbid any public dealing in any industrial security (for railroad and public-service securities the existing commissions afford ample protection to the public) unless its introduction is accompanied by a prospectus setting forth every material detail about the company concerned and the security offered, such prospectus to be signed by persons who are to be held responsible at law for any willful omission or misstatement therein. Such a law would be analogous in its purpose and function to the Pure Food law, and any, let us call it 'anti-fleecing,' law would overshoot the mark if it went beyond that purpose and function. The Pure Food law does not pretend to prescribe how much a man should eat, when he should eat or what is good or bad for him to eat, but it does prescribe that the ingredients of what is sold to him as food must be honestly and publicly stated." This is an excellent statement and recommendation. Its chief weakness is in that qualifying word "willful" that has been the safety of so many of the skin-game artists in mining promotions, who have been put to trial. There ought to be some limitation to the plea of ignorance, hopes, opinions, etc. There are certain things that the promoter of a mine *ought* to know, and in the omission of such knowledge and statement of it there should be nothing extenuating by the saving grace of its not being "willful," which is so difficult to prove.

Colloid Processes in Mineral Deposition

There is a growing appreciation of the tremendous rôle played by the colloids in the chemical processes which are going on at or near the surface. The many text-books devoted to colloid chemistry, recently issued—for instance, those by Taylor, Burton and Hatschek—bear evidence of the interest in this study. The biologists were the first to take up the application of colloid chemistry, but the agricultural and industrial chemists soon followed, and now the students of mineral deposits are beginning to realize that, in their field too, colloid processes are extremely important. The talented Cornu, of Vienna, whose tragic death robbed science of many valuable contributions, was among the first to urge the necessity of studying the colloids formed during the oxidation of ore deposits. A few investigators have taken up the subject in this country, and the little that has been done is enough to indicate what may be expected if the field is worked as it should be.

The problems of deposition of bauxite, of limonite, of phosphates, are all connected with colloid chemistry. Even in deposits formed below the surface similar processes are active. A few years ago Hatschek and Simon published an interesting paper on "Gels in relation to ore deposition," in which the problem of deposition of gold in quartz was touched upon. The paper was discussed in the "Transactions of the Institution of Mining and Metallurgy," and the valuable fact was brought out by one con-

tributor that quartz crystals actually formed in nature from a silica gel accumulated in a fissure accidentally opened up in a mine. The explanation of rhythmical precipitation in gels by Liesegang is also an important contribution, and its application is apparent in many cases of deposition of ores. Is it not possible that the extremely fine distribution of gold in certain deposits is caused by its precipitation in a colloid modification?

High temperatures are unfavorable to the existence of colloids, and so we may expect to find that in the more deep-seated deposits this form of solution plays a lesser part. But up to about 200° or 300° C., gels may easily exist, and recent investigation show that in some veins the quartz is really crystallized from a gel, the depositional surfaces of which are still visible. Still another discovery is that in alkaline solutions containing hydrogen sulphide, crystallized metallic sulphides may be "dispersed" into clouds of colloid material. It is probable that a careful study of the reactions going on in the humble and inconspicuous jellies will amply repay our investigators of mineral deposits.

The Belgian Relief

The break between the United States and Germany will greatly increase the difficulties under which the Commission for Relief in Belgium has labored. It may result in developments that will necessitate the administration being placed in the hands of another nationality. At present the mind of every member of the relief commission and of every thinking person is filled with the utmost anxiety as to the fate of the ten millions of people who are destitute in Belgium and northern France. No stone will be left unturned to reëstablish the transport of supplies to them, and continue the work.

In the words of Mr. Hoover, upon whose devoted head the new trouble falls most keenly, "No matter what contingency arises between this country and Germany, Americans must not desert the cause which has been so peculiarly our own, and we must give our every support to some other neutral body if we should be forced to retire from administration of the relief."

Since Hoover has been here Americans have contributed liberally to the cause, but subscriptions to Belgian Kiddies, Ltd., which is peculiarly the business of Hoover's professional colleagues, have lagged. This enterprise must be brought to a satisfactory conclusion.

Mining engineers, you must back up Hoover.

The Question of Secondary Chalcocite

For the time being the chemical side of the question of secondary chalcocite in ore deposits appears to be settled. The chemists of the geophysical laboratory of the Carnegie Institution have taken a hand in the matter, and in their usual thorough manner have established the main facts as to the deposition of this mineral on other sulphides. The investigations were quantitative throughout. The experiments with pyrite, chalcopyrite, pyrrhotite, bornite, sphalterite and galena show that the process always involves a formation of sulphate of the metals of the precipitating sulphides.

All the reactions were studied at several temperatures ranging from 200° down to 30° C. It was shown conclusively that at 50°, sulphides of copper (chalcocite or covellite) resulted from a reaction between pyrite crushed finer than 200-mesh, and cupric sulphate. The solution lost 52 mg. of copper in six months and a corresponding amount of iron sulphate and sulphuric acid was found in the solution.

This solves definitely a mooted question that long has occupied the attention of mining geologists. In the same manner chalcopyrite alters to covellite and chalcocite, while bornite and covellite alter to chalcocite alone. Sphalerite and galena are easily converted first to covellite and then to chalcocite. Many other important reactions have also been studied in this interesting investigation which throw light on secondary ores.

Drill-Sharpening Shop

Our esteemed civil-engineering contemporary, *Engineering News,* in an investigation regarding the modern efficient methods of tunnel driving, offered prizes for the best two articles on drill sharpening. The articles submitted were judged solely on their merits, and as a result, both the prizes were awarded for articles written by mining men, describing drill-sharpening shops at mines. This is not surprising, as it was to be expected that drill sharpening would reach its greatest efficiency at some of the large mining operations, where much more drilling is done and consequently more steel sharpened than in any tunnelling operation, where only one face is being drilled, even though it may be a large one and done in benches.

A tunnel job has a short life, and its drill shops, etc., are temporary. At a mine, on the other hand, the installation may be considered permanent. The pressure for speed is not greater to complete the tunnel than to accelerate mine production, so that every reason leads to the expectation that the best results would be accomplished and the best work done in the mining field.

The New Laboratory at Urbana

A new laboratory building of economic engineering was recently opened with appropriate ceremonies by the University of Illinois, at Urbana. The university is to be congratulated upon this step in advance, and it is indeed fitting that the new laboratories should be in Illinois, for this state is now the fourth in rank as to value of clay products, the figures for 1915 being given as nearly fifteen million dollars. The building is abundantly provided with all facilities for research in ceramics and is now also the headquarters of the State Geological Survey.

A handsomely illustrated booklet describes the new department of ceramic engineering and its equipment. Necessarily the geological features of this branch of engineering are not overlooked.

The scope of the industry, as stated in this pamphlet, seems a little too ambitious. Cermanics is there defined as the study of the occurrence, exploitation and subsequent manufacture of all nonmetallic natural substances including (besides clay) graphite, asbestos, gypsum, cement, slate, building stone, sulphur, soapstone, etc. Although low aim and not failure is to be depreciated, we are of the opinion that this is going a little to far and hope at least that the ceramic engineers will pause before including coal and oil in their realm of research.

BY THE WAY

It may or may not interest many readers to know that at present there enters into each Ford car 8.3 lb. of copper and 9.5 lb. of brass. This is a reduction of 3 lb. of copper in each car, according to the Boston *News Bureau*. As the Ford company announces that it will sell approximately 1,000,000 cars in 1917, the change indicates a reduction in their annual copper requirements of about 3,000,000 lb.

Arizona has now made it doubly sure that it is going to have a real governor, worthy of this high honor and responsibility in directing the affairs of the country's leading copper-producing state. On Jan. 27, the Arizona Supreme Court returned a decision holding that Thomas E. Campbell is the de facto governor of Arizona. This decision puts the proverbial "rollers" under Former Governor G. W. P. Hunt who claimed reëlection and declined to yield possession of the state capitol.

In the early days of rock drills at the Lake Superior copper mines, the first machines were clumsy "Burleighs." A pair of miners working with one at the Quincy had finished their round of holes and were ready to blast. One partner said to the other, "What are ee going to do by they machine?" The other replied "I don't know, lave un theer." "If we lave un theer, she'll be blasted." "Damnee, I don't keer. I wan't work with a partner I have to pack out to shaft. Lave un stay."

Finishing touches on the last 25-mi. stretch of electrified railway of the St. Paul is rapidly nearing completion. It is expected that the entire mountain division will be electrically operated before the end of the month. Early in December the line from Harlowton to East Portal, 406 mi., was in operation for passenger and freight service. One of most remarkable features of the installation is braking control to hold back trains on long, descending grades and to return power to the line. Every test has demonstrated the superiority of the electric motor over the steam engine.

A large display ad in the New York papers of the Keystone Mining Co., of Utah, by members of the New York Stock Exchange begins, "A prospect," and after a description of the property and a statement of the production of the district and the dividends paid by an adjacent mine and some other interesting figures in the millions, the ad states: "All the stock having been sold, this advertisement appears as a matter of record only," and winds up with the following disclaimer: "The above information, while not guaranteed, has been obtained from sources which we believe to be reliable."

The Mexicans are great leasers. They are often not over-particular as to the location of the lease; whether it is on the ledge or on a slag dump is a matter of little consequence. Not the least important thing about the business, however, is the fact that they invariably get a good-sized check from the smelter. In discussing this phase of the matter, one was heard to remark as follows: "If a man gets a lease and has to go out and dig to find the ore, there is not much profit in the business; but if a man can go out and get some ore that somebody else has dug for and found already, then there is some profit in it."

The demand for copper in the manufacture of munitions of war has restricted the use of the metal in many other ways, but one of its uses which has been little thought of is in the manufacture of tinsel goods. This industry has been almost entirely suspended in France, according to a statement by J. E. Jones, consul at Lyons, France, owing to government sequestration of plants formerly making tinsel, because it requires large quantities of copper. The United States alone took $909,788 worth of French tinsel goods in the first nine months of 1916, and it is believed that the closing quarter brought the total to more than $1,000,000.

"Attention, married booze fighters!" is the title of a pithy paragraph in the *Bulletin* of the University of Arizona Bureau of Mines. "To the married man who thinks he cannot get along without his drinks, the following is suggested as a solution to the bondage of his habit: First—Start a saloon in your own house. Second—Be the only customer, and you'll have no license to pay. Give your wife $2 to buy a gallon of whisky, and remember, there are 69 drinks in one gallon. Third—Buy your drinks from no one but your wife, and by the time the first gallon is gone she will have $8 to put in the bank and $2 to start business again. Fourth—Should you live ten years and continue to buy booze from her, and then die with snakes in your boots, she will have money enough to bury you decently, educate your children, buy a house and lot, marry a decent man and quit thinking about you."

"With the peace 'scare' Jerome had quite a setback, but the district is going to develop some more mines, peace or no peace," writes an engineer from this lively Arizona mining center. "But of all the wildcat camps that were ever started this is the wildest, and the reason is simply that they have big mines here and nobody knows why. There is less reliable information to be had about this district than about any I have ever been in. Good reliable business men and mining engineers are standing behind prospects here that have not a single sign of ore except in a few cases where there is a little green stain. Why? Because the Lord only knows what there is 1500 ft. underground. How do I know this to be so? Because I am trying to stand behind one myself. And the one I am standing behind at least has the geological conditions and a few ounces of real ore showing on surface. What there is down below is more than I am willing to guess at. But I am going to continue to stand behind it until the company either makes or breaks."

The Boston *News Bureau* thus summarizes how the once-brilliant prospect of "millions in it" for the American makers of war rifles faded into somber colors. In brief, the various stages in the rifle-contract business may be pictured as follows: (1) 10,000,000 military rifles wanted at once; (2) a profit of $150,000,000 predicted; (3) mad competition to get a slice of it; (4) probable profit reduced to $100,000,000; (5) construction delays,

scarcity of skilled men, costly material; (6) predicted profit reduced to $50,000,000; (7) allied governments to pay for new plants and promise to absorb all operating loss; (8) rejections, recriminations and remorse. Less than 500,000 rifles have actually been delivered, although shipments from all American factories are now going forward at rate of 10,000 rifles a day. On this basis—and it has taken two years to build our works up to this capacity—it would take over three years more to complete the entire transaction. However, the *News Bureau* is reliably informed that the Remington, Winchester and Midvale plants are delivering at the present time between 7000 and 8000 rifles per day and that from now out there should be a gradual speeding-up of production. The Westinghouse company appears to have managed the business better than the others and is expecting to realize a profit of at least $3,000,000 on its contracts.

A writer in the New York *Times,* Jan. 29, 1917, refers to Herbert C. Hoover, in connection with the commission for the relief of Belgium, as "the horse and the wagon and the dog under the wagon," in other words, "the whole works." Continuing, he says: "I think it is $200,000,000 altogether that has been raised for Belgium by the activities headed by Mr. Hoover. In a way, no other man outside official life has carried such a load. He has unhesitatingly sacrificed his private interests, which are very large. He has had the satisfaction, if he counts it so, of standing in the middle of the belligerents and dealing with them all. His fight has been on internal lines with a vengance. One week his business has been with the Kaiser, his generals and ministers; the next with the French government, and the next with the British Prime Minister. He will have material for many an interesting volume, if he should turn author after the war. Mr. Hoover's abilities have excited the greatest admiration in the highest circles. They have wanted him very much to become an English citizen, and I don't think that I exaggerate when I say that the House of Lords would not have been beyond his reach if he had consented to change his allegiance. But through all these years of residence in London he has kept his Americanism fresh, and nothing would induce him to give up his native country. As Mrs. Hoover feels the same way, they have lived their life and done their work in London, but as Americans, and will continue to do so."

One of those incidents which now and then come to light to add to the glamor and fascination of mining investments was revealed recently through the correspondence of the First National Bank of Wallace, Idaho. There was received from the National Bank of Commerce, of New York, a certificate of stock in the Hecla Mining Co., of Wallace, for 5000 shares, drawn in favor of M. L. Martin. Accompanying the certificate was a request that the bank collect the accumulated dividends and have the certificate reissued in the name of Mrs. Mary L. Humes. Attached to the certificate were affidavits establishing the identity of Mrs. Humes as M. L. Martin, and also a bond to indemnify the company from possible loss. The certificate was No. 41 and was issued in 1892, the year in which the Hecla Mining Co. was organized. It was signed by Patrick Clark, president, and John A. Finch, secretary, both of whom are dead. In carrying out the instructions from the New York bank, the local bank found that the books of the Hecla company showed a credit on account of dividends due the holder of certificate No. 41, amounting to $26,500, less $400 due for assessments unpaid. This amount was remitted to the New York bank to be delivered to Mrs. Mary L. Humes, together with a new certificate, which has a market value today of $8 per share, or $40,000. The original purchase price of the stock was 10c. a share, or $500, to which is now added the long overdue assessments of $400, making the total investment, $900, which at present represents a total value of $66,500. Hecla is paying monthly dividends of 15c. a share, which means that Mrs. Humes will continue to receive $750 per month. For years the company made diligent effort to find the holder of this stock, but without success, the task being made more difficult by the fact that it was not known whether M. L. Martin was a man or woman. The stock could of course have been sold to pay delinquent assessments, but the management very considerately protected the owner.

Government mining on the Far East Rand has been the subject of much lengthy discussion in South Africa. The leading objections to state mining are succinctly stated in the annual address of Chairman S. B. Joel at the recent meeting of the Johannesburg Consolidated Investment Co.—the so-called "Johnnies" or Barnato group, with the largest gold production on the Rand. Mr. Joel said: "In the first place, we must all admit that, even with the best expert advice we are able to obtain, mining is, always has been and always will be risky and highly speculative. I have yet to learn that the government is entitled to gamble with the funds entrusted to its care any more than any other trustee. But apart from the initial risk, which is the greatest objection of all, there are three points against state enterprise of this nature that stand out so prominently that any one of them is, in my humble opinion, more than sufficient to spell disaster. I refer to the enormous amount of capital required for development and equipment and the length of time this amount must remain unproductive (some seven years), the labor difficulties that must inevitably arise in a state-managed concern, and lastly but very importantly, the possibility of interference with the management and control by political influence thus interrupting that continuity of policy and management which is so essential to the success of a mining proposition. I think I may rightly claim to speak with some authority on the possibilities of mining in this particular area, and although the Government Areas, in which we are so largely interested, has proved itself a success, I can assure you that for a considerable period, and not so long ago, the proposition was a cause of grave anxiety. I very much doubt if any government, having expended a million pounds upon what then appeared to be an unpayable proposition, would have felt justified in following the course I adopted of putting another million into the venture. Had this not been done, the inevitable result must have been that the total area of the Far Eastern Rand would have been utterly discredited and the country would have suffered an irretrievable loss." The Government Areas mine, which Mr. Joel's company so persistently developed, now has reserves of over 4,600,000 tons of $7 ore and a milling plant with a capacity for treating 120,000 tons monthly.

Personals

Prof. Waldemar Lindgren has gone to Chile on professional business.

John T. Reid will be in New York on Feb. 15 for a two-weeks' visit. He will return to Lovelock, Nev., about Apr. 1.

H. W. Darling, lately connected with the Porcupine Crown mine, has been appointed manager of the Dome Lake, Porcupine.

John Greenway, of Bisbee, Ariz., has requested to be allowed to enlist under the command of Colonel Roosevelt, in case the latter raises a body of troops.

T. O. McGrath, auditor of the Shattuck Arizona Copper Co., Bisbee, Ariz., is in New York for two weeks on his annual trip relative to copper sales and accounts.

Eugene Steindler, president of the Dominion Reduction Co., is in New York, in connection with plans for the company's entering the Kirkland Lake gold field.

Walter Douglas has been appointed member of the committee on revision of the mining law in place of Dr. James Douglas, his father, who was unable to accept owing to ill health.

D. D. Hull, Jr., was elected vice-president of the Virginia Iron, Coal and Coke Co. at a meeting of the board of directors in New York, Jan. 23. His headquarters will be at Roanoke, Va.

S. S. Sorensen, general manager of Braden Copper Co., who has been in the United States for several months, enjoying a much needed vacation, expects shortly to return to Chile.

T. M. Stanton, late superintendent of mines for the Cananea Consolidated Copper Co., Cananea, Mexico, has gone to South America as mine superintendent for the Cia. Estañifera de Llallagua, at Llallagua, Bolivia.

Jos. A. Silver, formerly president of the Silver Iron Works, Salt Lake City, is president of the Silver Steel Tie Co., Woolworth Building, New York City, promoting a device to do away with wooden railway ties of which he is the patentee.

Dr. L. D. Ricketts has returned from the West where he has been enjoying a holiday. About the end of February he will leave for South America to inspect the operations of the Andes Copper Co. He expects to be back from South America about the end of May.

E. A. Barnard, for the past five years member of the engineering staff at the Washoe smeltery, at Anaconda, Mont., left on Jan. 29, for Madison, Wis., where he will be an instructor in the mining and metallurgical department of the University of Wisconsin.

Herbert C. Hoover was honor guest at a luncheon given on Feb. 6 by the American Mining Congress. The affair was arranged by a committee consisting of Van H. Manning, director of the Bureau of Mines; George Otis Smith, director of the United states Geological Survey; Capt. A. F. Lucas, of the American Institute of Mining Engineers; A. H. Brooks, of the Mining and Metallurgical Society of America and J. F. Callbreath, of the American Mining Congress.

Obituary

Charles J. Moore, 68, one of Colorado's longtime mining engineers, died at his home in Denver, Sunday, Jan. 28, his demise being ascribed to a complication of stomach disorders coupled with mental unrest due to the European war in which several of his close relatives are engaged. He was born in Liverpool, England. He came to Colorado in 1872 as the engineer for an irrigation company. Remaining here permanently, he practiced his profession at Leadville, Cripple Creek, Goldfield and throughout the West generally. He made a special study of the geology of the Leadville and adjacent mining districts, and owned properties therein. At one time he was consulting engineer for the Portland Gold Mining Co. The funeral occurred at Denver, Jan. 30, under the auspices of the Christian Science denomination.

Alfred Thielen, mining engineer, died Jan. 11, at his home in Leadville, Colo. He had been ill for several months with stomach trouble and had recently returned from the Minnequa hospital, Pueblo, where he underwent a serious operation. Although, toward the last, he was troubled with a complication of disorders, he was daily about, and his death came as a shock to his many friends, he passing away instantly while dressing himself. He was born at Springfield, Mass. As a young man, in 1879, he located in Leadville and soon became active not only in his profession but also in civic affairs. He was a United States mineral surveyor, member of the city school board for several terms, and member of the Fraternal Order of Elks. Since 1891 he had been consulting engineer for the Ibex Mining Co. His funeral was conducted by his fraternity, Sunday, Jan. 14.

Societies

American Society of Civil Engineers held a meeting at the Society House on Wednesday, Feb. 7, 1917, at which a paper by A. C. Dennis, on "Construction Methods for Rogers Pass Tunnel" was presented for discussion.

Engineers' Society of Western Pennsylvania held the annual meeting of its Mechanical Section on Feb. 6, 1917. The meeting was preceded by a dinner at the William Penn Hotel, Pittsburgh, after which the members went to the society rooms in the Oliver Building. The discussion was on "Burning of Blast-Furnace Gas Under Boilers."

University of Idaho, Moscow, Ida., started its short course for prospectors, miners and millmen, offered each year by the University of Idaho at Moscow, began Jan. 8. The course continues for two months and students may enroll up to Feb. 1. The course includes studies in chemistry, mineralogy, petrology, geology, prospecting, mining, assaying, ore dressing, and milling. Professors E. K. Soper and R. R. Goodrich have charge of the work.

College of the City of New York offers courses in business education and provides a way in which those unable to begin study last fall can save a full academic year by special study now. The courses are for evening work, and include accounting systems, practical auditing, cost accounting, marketing and foreign exchange, economics, etc. Enrollments may be made now at the registrar's office. Courses are open to all citizens of New York.

Nevada Mine Operators' Association at a meeting held Jan. 20, 1917, reëlected John L. Kirchen as president. J. H. Hutchinson, of the Goldfield Consolidated, was elected first vice-president, and W. A. Blackbun, of the Tonopah Mining Co., second vice-president, and Henry Rives, secretary. A new executive committee was named consisting of the officers and L. A. Friedman, of the Rochester Mines Co., Frederick Bradshaw, of the Tonopah Development Co., E. A. Julian, of the Nevada Hills Co., and C. V. Jenkins, of the Nevada Consolidated, at Ely.

Southwestern Society of Engineers, erroneously reported in the "Journal" of Jan. 13, 1917, as the Engineers' Society of Texas held the meeting reported at El Paso, and not at Austin. The society is intended to include engineers of all branches in Texas, Arizona and New Mexico. The constitution committee has practically finished its work and that the committee on program is now working on the arrangements for a convention to be held in March. Just prior to this convention, a meeting to adopt the constitution will be held, and up to this date charter members will be received.

Trade Catalogs

Stanley Cotton Belting.. Stanley Belting Corporation, 32-40 South Clinton St., Chicago, Ill. Pamphlet; pp. 8; 3½x6 in.

Draeger Self-Rescuer. The Draeger Oxygen Apparatus Co., 422 First Ave., Pittsburgh, Penn. Bulletin; pp. 8; 6x9 in.; illustrated.

Sullivan Rotator Hammer Drills. Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. Bulletin No. 70A; pp. 24; 6x9 in.; illustrated.

Type "B" Pulmotor—Hand Operated. The Draeger Oxygen Apparatus Co., 422 First Ave., Pittsburgh, Penn. Bulletin; pp. 8; 6x9 in.; illustrated.

Vasco-Marvel Semi-High-Speed Steel. Vanadium-Alloys Steel Co., Pittsburgh, Penn. Folder describing this steel, also containing high-speed steel standard classification of extras adopted July 22, 1915.

Mesta Automatic Valves (Iversen Patent). Mesta Machine Co., Pittsburgh, Penn. Bulletin D; pp. 8; 6x9 in.; illustrated. This bulletin describes the application of these valves to old and new compressors, pumps, etc.

S K F Self-Aligning Ball-Bearing Hangers and Pillow Blocks. S K F Ball Bearing Co., Hartford, Conn. Bulletin; pp. 48; 6x9 in.; illustrated. This contains tables and curves and engineering data on mounting, lubrication, testing lubricants, etc.

Spraco Equipment for Washing and Cooling Air. Spray Engineering Co., 93 Federal St., Boston, Mass. Bulletin No. 250; pp. 16; 8½x11 in.; illustrated. The equipment shown in this bulletin is especially applicable for steam turbine generators and other electrical machinery.

Injectors, Ejectors, Grease Cups, Etc. Penberthy Injector Co., Detroit, Mich. Catalog No. 28; pp. 80; 6x9 in.; illustrated. In addition to a great deal of data on injectors this shows a complete line of brass specialties pertaining to steam, plumbing and automobile accessory trades.

Cochrane Heaters for Steam Power Plants. Harrison Safety Boiler Works, Philadelphia, Penn. Catalog No. 710; pp. 106; 6x9 in.; illustrated. Descriptive of the utilization of exhaust steam and the heating, softening and metering of boiler feed water as accomplished by Cochrane apparatus.

Industrial News

Alberger Pump and Condenser Co. has opened a branch office at 1418 Pennsylvania Building, Philadelphia, Penn. It is in charge of H. W. Wetjen.

Jeffrey Manufacturing Co. has recently opened a branch office at Cleveland, Ohio, at 421 Rockefeller Building. The office will be in charge of W. E. Holloway and C. B. Reed.

Westinghouse Electric and Manufacturing Co. has purchased about 500 acres of land at Essington, Penn., near Philadelphia, which will form a new industrial center for the Westinghouse Electric interests. The new center will be devoted to the production of large apparatus; power machinery, steam turbines, condensers and reduction gears. Initial development will involve expenditure of $5,000,000 or $6,000,000, occupying about one-fifth of the area acquired.

Layne & Bowler Corporation, of Los Angeles, Calif., has built for the El Paso & Southwestern R.R. two 30-stage centrifugal pumps to be installed in a 12-in. bored well; the pumps are to work against a total head of 600 ft. and to handle 250 to 350 gal. per min. About two years ago the Layne & Bowler Corporation installed a 15-in. 18-stage turbine pump for the City of Glendora, Calif.; this is installed at a bored well, 400 ft. deep, and 450 to 500 gal. per min. is being pumped.

Newport Turpentine and Rosin Co. has recently completed a new plant at Pensacola, Fla., for the extraction of turpentine, rosin and pine oil by steam and solvent methods from finely shredded pine wood. The product of the new plant, together with the company's older one at Bay Minnette, Ala., will approximate 65,000 bbl. of rosin and 20,000 bbl. of turpentine and pine oil annually. All of the output is marketed by the General Naval Stores Co., of New York, which supplies much of the oil for flotation plants.

Walter Kidde & Co., Inc., has been formed to take the business of Walter Kidde, engineer and constructor, 140 Cedar St., New York. The business was established in 1900, and from the first the functions of the engineer and constructor was combined, as it was believed that in this way the common interests of the client and the constructor could be best served. Among establishments designed and built is the well-known plant of the Barlow Foundry, of Newark, N. J., which has received the unqualified praise of the New Jersey State Labor Commission. Mr. Kidde has a keen appreciation of the great importance of the chemical industry in this country, and the members of his staff have made a thorough study of the requirements of chemical plants. A good example of their work in this field is the plant of the Monmouth Chemical Co., at Keyport N. J., which is devoted to the manufacture of potassium chlorate. In this undertaking not only was the entire plant constructed and equipped, but the process of manufacture had to be developed and perfected. This was successfully accomplished.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Concentrator.—Arthur O. Gates, La Fayette, Ind. (U. S. No. 1,213,348; Jan. 23, 1917.)

Drill Extractor.—William W. Wilson, Wonder, Nev. (U. S. No. 1,213,989; Jan. 30, 1917.)

Drill Steel—Apparatus for Forming Lugs Upon Drill Steel. Theodore H. Proske, Denver, Colo. (U. S. No. 1,214,070; Jan. 30, 1917.)

Mine Car Brake—Safety. Isaac A. Machamer, Wiconisco, Penn., assignor of one-half to Andrew Budd, Allen Budd, and Richard Budd, Williamstown, Penn. (U. S. No. 1,214,341; Jan. 30, 1917.)

Mine Hoist—Safety. George F. Royer, Wilkes-Barre, Penn. (U. S. No. 1,213,956; Jan. 30, 1917.)

Metallurgical Furnace—Roof-Crown for Open-Hearth Furnaces. Theodore Poull, Birmingham, Ala. (U. S. No. 1,214,066; Jan. 30, 1917.)

Ore Separators—Attachment for Dry Ore Separators. William W. Bonson, Dubuque, Iowa. (U. S. No. 1,214,269; Jan. 30, 1917.)

Portable Hoist—Ernest C. Wingire, Minneapolis, Minn., assignor of one-half to Peter J. N. Miller, Miller, S. D. (U. S. No. 1,214,101; Jan. 30, 1917.)

Zinc—Recovery of Zinc. Charles H. Fulton, Cleveland, Ohio, assignor to David B. Jones, Chicago, Ill (U. S. No. 1,213,180; Jan. 23, 1917.)

Zinc Furnace—George Lundress and Leyland Rogers, Clarksburg, W. Va. (U. S. No. 1,213,422; Jan. 30, 1917.)

Editorial Correspondence

SAN FRANCISCO—Feb. 1

January Weather in California was the coldest since 1913 and the winter season began earlier than any other in the same period. The snow in the higher elevations has been heavy and the indications are good for an abundant supply of water for mining and agricultural uses in the coming spring and summer. The cold has been severe in the mountain regions; the storms extraordinarily disastrous. In fact the entire winter has been more like an Eastern winter than Californians have been used to.

Reclamation of Dredged Placers for agricultural uses is having a second demonstration in the American River district through the operation of Natoma No. 1 dredge, reconstructed and placed in commission in November, 1916. The original Natoma No. 1 was installed in May, 1908, and was the first dredge in California equipped with buckets of greater capacity than 9 cu.ft. The introduction of 13½-cu.ft. buckets was looked upon as an innovation that would be more attractive as history than useful in the practical and profitable operation of the industry. Results show that the 13½-cu.ft. bucket was merely the forerunner of the 15- 16- and 18-cu.ft. buckets, and there are indications that the deeper placer fields may be dug with buckets of 1-cu.yd. capacity. The greater the possibilities for reclamation of ground fit for agricultural purposes the easier the digging. A small boat, equipped with large buckets, makes an ideal dredge for this character of placer work. So when Natoma No. 1 was reconstructed with four tailing stackers the bucket capacity was increased to 15 cu.ft. This dredge is not the first to undertake the reclamation of the ground coincident with the recovery of the gold but is probably to be the first whose design and operation will form the standard principle upon which this class of dredges will hereafter be built. Natoma No. 4 dredge was reconstructed and placed in commission in the early part of 1916 with the purpose of reclaiming the ground, and succeeded after some additional improvements were made. But No. 4 was designed with only two tailing stackers and its early performance was rather discouraging. At the time No. 1 was placed in commission with the four tailing stackers, No. 4 dredge was under successful and satisfactory operation. The bucket capacity of this dredge is also 15 cu.ft. It is not expected that either No. 4 or No. 1 will meet every demand for the reclamation of placer ground, but the essential improvement will perhaps be confined to changes in details of construction rather than in any radical change of plan.

Electric Power for Plumas County Mines is assured by recent action of the State Railroad Commission in dismissing an injunction brought by the Plumas Light and Power Co. against the Great Western Power Co. The complainant serves the town of Crescent Mills with electric lights and some power, and although it has a power plant, buys electricity from the Great Western. It was apparently evident to the commission that the Plumas Light and Power Co. is not equal to the power demands of the mines in this region of copper and gold mining and that the Great Western is fully equipped for extension of its lines and supplying all the electric power that the mines may require. The successful operation of the copper and gold mines of central and southwestern Plumas County is dependent upon the availability of cheap power. The mineral development was for many years badly handicapped by lack of rail transportation, until the Western Pacific Ry. was built, and by the fact that the seasons for outdoor mining work are short, owing to the high elevations in which the mines are situated and the extreme cold and heavy snows in the winter. But the Plumas County prospectors were persistent and patient while investors were slow to appreciate the great mineral resources of the county. The development of copper deposits was not seriously considered outside of the county until five or six years ago; but for more than 15 years prior to the first commercial production of copper there were three mines in which development or assessment work was kept alive. In 1912 the Engels and the Walker copper mines were attracting some attention and in that year the copper output of the county was 6963 lb. valued at $1149; in 1915 Plumas County produced 3,164,496 lb. of copper valued at $353,787. This advancement was accomplished without direct rail transportation—necessitating team or motor haulage a distance of 25 to 40 mi. from mines to railroad—and without electric power. Now that the electric power is assured and a branch railroad is under construction through Indian Valley the great mineral wealth of central Plumas County is attracting the attention of large investors, and the owners and operators who have held on for 20 years awaiting transportation and power, are now reaping the results of their persistence and labor. The total production of Plumas County minerals in 1916 has placed the county in the million dollar class and there is every reason to believe that it will continue to advance in the production of copper, gold and silver.

DENVER—Feb. 2

Workmen's Compensation in again up for consideration before the state legislature. Two years ago a law was passed making this form of insurance compulsory in Colorado. The industrial relations commission is now back of a measure proposing that the weekly payment to an injured employee shall be $15 instead of $8; that the maximum payment for a fatal accident be $5000 in place of $2500 and applicable whether or not the victim has dependents; that the disability period be reduced from 21 to 14 days; and that the state adminster the funds. These suggestions are opposed by members of the metal-mining industry who feel that they are already severely over-taxed. At present, compensation insurance placed with old-line companies costs an employer $3.85 per $100 of payroll. Should the suggested changes be made the average cost will probably run up to about $7. During the prevailing high prices for the metals, probably most of the state's mines could share this additional burden but, should metal prices drop back to their past averages, it is doubtful if a great many could stand the increased operating costs due to this measure. No mine owner wishes to avoid his share of taxation but there prevails a feeling that the mining industry of Colorado is bearing an unjust proportion of the state's expenses.

A Leasing Enterprise in Leadville of more than ordinary interest is that of a company, organized by James Daniels, of Leadville, to operate the old Gray Eagle, Crown Point and the Wildcat claims on Carbonate Hill, east of the Penrose. These properties were originally in the control of the Down Town Mines Co. Preparations for operating through the Gray Eagle shaft are nearing completion. A new headframe has been erected and steam-hoisting machinery installed. Retimbering in the shaft will be started shortly. The shaft is estimated to be 500 ft. deep and has been idle for at least 20 years. The Gray Eagle was important in the early-day history of the district as a producer of high-grade silver-lead ores. It was first operated by Eben Smith and David H. Moffat, two pioneer mining men widely known throughout the West. The present operators expect to uncover bodies of silver-bearing iron and iron-manganese ore in the Gray Eagle and Crown Point. Large stopes of such ore were opened in the Bison adjoining the Gray Eagle and worked up to the Gray Eagle line. The leasing company is well financed and plans extensive development throughout the property.

BUTTE—Feb. 1

The Extra Mine Taxation Proposed has resulted in so many protests being received in the committee rooms of the legislators that a change in the form of taxation is now in view. A bill is now being framed providing for an income tax upon all corporations, companies, copartnerships and persons doing business in the State of Montana. It will likewise be recommended that a tax commission be named to carry on an investigation during the next two years in order that property values for taxation purposes may be properly adjusted. This is intended to distribute the tax burden more equally upon all the industries in the state and meantime to provide an increased revenue, pending the adjustment of taxation by the permanent commission to be appointed for that purpose.

Butte & Superior's Legal Troubles continue. It is still involved in the big legal war with the Minerals Separation Co. over the flotation process. Now another chapter has been added to Butte & Superior's legal history by the filing of a motion for a supplemental suit before the Federal District Court in Butte by the W. A. Clark interests, owners of the Elm Orlu Mining Co. At the time the court handed down its decision in the original suit between the Butte & Superior and Elm Orlu companies over the rights of the two companies to certain ore-bodies that were claimed by both, the decision as to where the Rainbow lode ended and the Pyle "strand" began was reserved. The court intimated that until further development work was done, it would be difficult to decide that point. Since then both the Elm Orlu company and the Butte & Superior have been carrying on development work rapidly in the ground referred to and the mining of ores has been going steadily ahead in the disputed district. For the last three weeks the Clark interests have had engineers making an examination of the work done by both companies and of the mining carried on by Butte & Superior. As a result of the engineers' reports, the supplemental bill has been filed. In this bill the court is asked to define definitely where the Butte & Superior rights end and the rights of the Elm Orlu company begin. It is also claimed that Butte & Superior has been taking ores belonging to the Elm Orlu company and an accounting is asked of the court.

Butte & London's Future is now uncertain. Since the closing of the mine, the management has announced that no efforts are being made at present to get the Rainbow Exploration Co. and the Cole-Congdon interests to do any further development and the company has no funds on hand for that purpose. Opinions as to the intrinsic value of the mine are divided, some claiming that the veins encountered were of no commercial value while others claim the reverse. As the pumps have been drawn and the mine allowed to fill with water, the actual facts will perhaps never be known, unless these veins are tapped by crosscuts from the North Butte or Rainbow properties in which Messrs. Cole and Congdon are interested. This has been suggested as being a more economical procedure than to operate Butte & London as a separate mine.

Organization of Montana Mining Interests is proposed as the aftermath of the legislation introduced in the state legislature adverse to the mining industry. This movement has served to unite interests that have been fighting each other for more than a score of years. In a letter just sent to practically every mining man in the state, the committee on organization sets forth the need of mining men getting together. The letter says: "It is the intention of the men interested in the mining industry in Montana to form a permanent organization for the mutual benefit and protection of the miners, prospectors, mine owners, mine operators, and others interested in the mining industry in Montana. We need no further evidence of the necessity of such an organization than the bills that have been introduced at this session of the legislature at Helena aimed directly at the mining industry. We urge your coöperation and ask you to see personally all mining men of your vicinity with the idea of immediately forming a local branch. Several local organizations have already been formed." Representatives of all important mining companies of the state are on the organization committee. The new organization will not only devote its attention to legislation affecting the industry, but later it is the intention to broaden the field of usefulness of the new organization and make it a power. One of the propositions is to raise the standard of mining promotions and to see that fraudulent mining propositions are dealt with in a manner to protect the innocent investors. The legislature will be asked to enact laws that will make it possible for any person to find out all the real facts about any mining company of the state before investing. Wildcat schemes will probably find a most determined and persistent foe in the new organization. In the matter of freight rates, reduction charges and costs of supplies and materials, the new organization is expected to take an important position. The movement has met with far greater success than its original promoters anticipated.

SALT LAKE CITY—Feb. 1

Land-Patent Applications in Utah for the month of December were much heavier than is usual at this season, indicating the great mining activity. Altogether there were 55 applications entered at the office of the United States surveyor general for Utah. Twenty-three were from Piute County, Gold Mountain district; 21 from Deep Creek or Clifton mining district; three from Tintic district; remainder scattered.

Utah Copper Co.'s Production for 1916 amounted to 196,752,631 lb. copper. In 1915 it was 148,397,006 lb., and in 1914, 115,599,445 lb. The output in December, 1916, was 13,965,533 lb. as compared with 16,421,192 lb. the month preceding, and with over 20,000,000 in July, August, September and October. Heavy snow storms and unusually cold weather in the latter part of the year made mining, milling and transport conditions difficult. Work had to be entirely suspended for about a week in the latter part of December on account of snow. The conditions at present are somewhat better, and 16 out of the 22 steam shovels are operating; daily production of ore amounts to 21,500 tons. Dividends were paid during 1916, amounting to $12 a share on the

1,624,490 shares of stock outstanding, or a total of $19,494,410. In 1915, $6,899,700, or $4.25 a share was distributed. Total dividends to date amount to $52,161,110.

JOPLIN—Feb. 2

Another Safety and Sanitation Campaign to bring about improved conditions in the mines of this district has been launched by the U. S. Bureau of Mines. W. D. Ryan, safety commissioner, was here several days recently, and with him was Dr. W. A. Lynot, who has started a program of lectures and practical demonstrations of first-aid work at the change houses of the larger mines.

HOUGHTON, MICH.—Feb. 2

Working Old Mines often involves "grief" that new operations are happily free from. A new mine, to be sure, may open a strong watercourse, but there is usually time for the men to get away, which is not always the case with the old mine. The recent experience of the Isle Royale illustrates some of the difficulties encountered in handling old mines in the Lake Superior district. The Isle Royale company, when it commenced operations on the old Portage lode, expended $60,000 in diamond drilling, punching holes to find water-filled old workings north of its No. 1 shaft. The maps left by the previous corporations were crude and while fairly reliable did not include everything. In fact the old Portage company had twice gone bunkrupt and when turned over there were few office records of importance. Under the circumstances and for the safety of the men, diamond drilling was conducted on an elaborate scale to prevent a washout. Yet the recent disaster, in which two men lost their lives and many others escaped by rare good fortune, came when the miners blasted right into an old Portage working and let loose tons of water. The diamond drill had touched every corner but the one where the water happened to be.

WASHINGTON, D. C.—Feb. 6

Mining-Code Revision should be preceded by a careful survey of the industry, and Representative Taylor, of Colorado, who has been an insistent champion of the plan to have a commission study the needs of the metal-mining industry before attempting a revision of the mining code, is now hopeful of accomplishing satisfactory results through the committee appointed by Van. H. Manning, director of the Bureau of Mines. Chairman Foster of the House Committee on Mines and Mining has requested Director Manning and his committee to submit a bill for consideration at the next session of Congress. To insure prompt action when Congress assembles in December, Mr. Taylor says it will be necessary for a completed draft of the bill to be available not later than Sept. 1. This will be necessary, he believes, in order to give members of Congress an opportunity to consult with their constituents and to study the effect the provisions of the bill would have on local mining conditions, if it should become a statute. Any bill which does not take into consideration the man with the burro, declares Mr. Taylor, can not hope for favorable consideration. He believes the present law must be the basis of the new code and hopes that changes, with their necessarily unsettling effects, will be held to the absolute minimum.

TORONTO—Feb. 2

On 1600-Ft. Level of Beaver Mine, at Cobalt, a 6- to 8-in. vein of high-grade ore has been opened that is locally regarded as having an important bearing on the life of the Cobalt camp. The wall rock on both sides of the vein is also stated to carry native silver for about 3 ft. The finding of good ore at the lower contact created much excitement in mining circles and was followed by a strong upward movement in the stock market. It is regarded as justifying confidence in the undertaking of deep mining operations on other properties in that section of the Cobalt district.

The Mining News

ALASKA

KENNECOTT (Kennecott)—Estimated January copper production, from Kennecott and Beatson, 7,080,000 lb.

ALASKA MINES CORPORATION (Nome)—Has acquired Johnson property of seven acres; company's holdings now embrace 2235 acres.

ARIZONA

Cochise County

CALUMET & ARIZONA (Warren)—Copper production in 1916 was 73,790,000 lb., as against 65,268,000 lb. in 1915.

SHATTUCK-ARIZONA (Bisbee)—Plans erection of 300-ton mill to treat silicious oxidized lead ore, averaging 10 to 12% lead, $1 gold and 6 oz. silver; estimates 1,000,000 tons of such ore developed. January production was: Copper, 1,415,303 lb.; lead, 425,638 lb.; silver, 19,105 oz.; gold, 211 oz.

Gila County

MIAMI (Miami)—Copper output in 1916 was 53,518,000 lb., as against 41,832,000 lb. in 1915. January output 5,020,000 lb.

INSPIRATION (Miami)—Estimated January copper output 11,600,000 lb. Production in 1916 was 120,749,000 lb.; first half only 53,850,000 lb.

Mohave County

GOLD ORE (Goldroad)—Manager A. C. Werden announces that test of Minerals Separation flotation method will be made before plans for new mill are decided.

Pinal County

RAY CONSOLIDATED (Ray)—December copper output 7,838,132 lb.; total for 1916 was 77,853,000 lb.; 1915 production 60,338,936 lb. Mill extraction during last quarter of 1916 was 75.3%, as compared with 71.4% during third quarter.

UNITED MAGMA MINES CO. (Superior)—New flotation of Lefkovits Brothers. Property comprises 34 claims, west of the Magma.

TROY-ARIZONA COPPER (Troy via Kelvin)—Equipment has arrived for Climax shaft which is to be made into three-compartment working shaft, and is to be sunk 800 ft. or deeper. This property about 1 mi. west of the Rattler mine.

TORTILLITA COPPER (Redrock)—A 60-hp. hoist installed to expedite sinking of 500-ft. shaft 300 ft. deeper. Property comprises 340 acres, 14 mi. northeast of Redrock. Western office, 32 North Stone Ave., Tucson; New York office, 299 Madison Ave.

Yavapai County

BIG LEDGE DEVELOPMENT (Humboldt)—Reported to have acquired the Sterling mine near Providence camp in the Big Bug district.

CALIFORNIA

Amador County

SOUTH KEYSTONE (Sutter Creek)—Permitted to issue 183,000 shares to William Virges and 30,000 shares to John A. McIntire in exchange for North Star and option to purchase South Keystone, Boyson and McIntire claims at $100,000. Also permitted to sell 87,000 shares at 50c. for further exploration.

Calaveras County

ISABEL GOLD DREDGING (Jenny Lind)—Constructing 6½-cu.ft. dredge, on area below old dredging ground; dredge should be ready about Mar. 15.

SAFE DEPOSIT (Mokelumne Hill)—Preparing for hydraulicking; gravel will be raised by hydraulic elevator; 1000 in. of water available. G. H. Burgess, superintendent.

Eldorado County

WOODSIDE (Georgetown)—Mine situated in center of town; will be reöpened by A. S. Westover and associates forming the Woodside-Eureka Mining Co. of San Francisco.

Nevada County

DREDGING AN ORCHARD, owned by Hughes brothers, at North San Juan, is to be undertaken by F. V. Flint, who bonded 200 acres. Orchard has borne fine fruit, but land is said to be more valuable for the gold there is under the surface.

GRASS VALLEY CONSOLIDATED (Grass Valley)—Permitted to sell additional 100,000 shares at $1 per share, for development and for completing equipment on Allison Ranch mine. Has options on Syndicate group at $40,000 and Keystone claim at $1500.

Plumas County

ENGELS COPPER MINING (Keddie)—Preparing to increase milling plant to 4500 ton daily capacity; will be divided into six 750-ton units. The No. 6 tunnel opened orebodies 300-ft. lower than previous workings. Building 26-mi. standard-gage railroad from Paxton on Western Pacific to the mines.

San Bernardino County

STRONTIUM DISCOVERIES, just north of Barstow, Calif., are to be examined by the U. S. Geological Survey at once with the object of securing an idea of the importance of the deposits.

Trinity County

LEWISTON DREDGING CO. (Lewiston)—Reported that cleanup of a 16-day run in December amounted to $19,748. H. E. Chesebro, manager. This 11-cu.ft. dredge has been operating on Trinity River about 4 years.

COLORADO

Dolores County

RICO CONSOLIDATED (Rico)—This company controlled by the Knights of Provo, Utah, has nearly completed its long tunnel from Silver Creek. George Garren, superintendent.

RICO MINING (Rico)—Bids being asked for driving tunnel at Syndicate mine; other work suspended until spring.

San Miguel County

SILVER BELL (Ophir)—Crosscut tunnel now in 2600 ft.; in hard diorite, only 170 ft. having been driven in last two months.

COLORADO-SUPERIOR (Telluride)—New skip at Black Bear mine in operation. Twenty-five stamps at the Smuggler-Union mine being used on this ore.

Teller County

DEXTER (Victor)—Main shaft, now 1300 ft. deep, is to be sunk to the 1400 level. The sinking will be done by Lessees Anderson & Benkelman who are developing a block of ground in the Trail mine of the United Gold Mines Co. immediately adjoining the Dexter.

C. K. & N. (Cripple Creek)—Dump being operated by Frank Cottier and associates under lease. The product sorted for shipment runs from $4 to $6 a ton.

GOLD KING (Cripple Creek)—Zenith Gold Mining Co. is operating through this property on El Paso vein under lease. Work being done on second, fourth, and seventh levels of Gold King shaft. Bert Gilbert is superintendent.

VINDICATOR (Goldfield)—It is estimated that dumps contain 1,800,000 tons of ore that can be treated at profit of 50c. a ton. Underground development, last year, amounted to 22,029 ft., of which 8294 ft. were driven by lessees. Total development to date amounts to 245,106 ft. Most important recent development work has been done at the 2000-ft. level of the Golden Cycle shaft, and at the 1900-ft. level of the Vindicator shaft. It is estimated that three-quarters of the probable mineralized area of the property remains undeveloped. Additional systematic development work is planned. Present ore reserves total 412,796 tons. Present cost of operation is a little over $2 a ton. During the last year the Vindicator concentration mill treated 127,947 tons of ore of an average value of $1.68 a ton. The average cost of milling was 17.4c. a ton, leaving a profit of about $1.50 a ton. Experiments in flotation test mill have given encouraging results. Pumps installed on 2000-ft. level of mine to raise water to the 1800-ft. level. A three-ton storage battery locomotive will be installed on the 1700-ft. level. Irving T. Snyder, general manager.

IDAHO

Owyhee County

DEMMING MINES CO., (Demming, via Murphy). This company, a subsidiary of the Rowland Corporations, has purchased the Talmadge and Bobolink groups, comprising 240 acres, for $32,500. Over $60,000 expended lately in the company's development in the new Demming gold field. M. T. Rowland, Nampa, Idaho, president.

MICHIGAN

Copper

AHMEEK (Ahmeek)—Running seven heads of the mill at Hubbell on its own rock. The eighth head is now in operation stamping LaSalle rock. The Ahmeek mill now has a stamping capacity of about 5500 tons.

INDIANA (Rockland)—Shaft angle altered to follow new unidentified lode that passed out of the shaft into the hanging wall. Work at other shaft, to explore lodes discovered by diamond drills, has been unsuccessful and operations suspended.

CALUMET & HECLA (Calumet)—Daily rock tonnage now about 10,350 tons. Contract let for three-ton electric furnace to be installed in the foundry at Calumet; extension to foundry almost completed.

MICHIGAN (Rockland)—Western drift, on sixth level, on Butler lode, discontinued because of the decline in copper content, but raise is being driven to examine other lodes. Eastern drift on fifth level encountering good ore.

NEW ARCADIAN (Houghton)—New Arcadian lode intercepted in crosscut from shaft on 1500-ft. level at distance of about 90 ft. The vein

on this level is approximately 25 ft. thick. Crosscut now about 40 ft. beyond the lode.

MISSOURI

Joplin District

VESUVIUS (Carthage)—New 250-ton electrically driven mill in operation. First turnin made. Shaft recently put down on new portion of lease is in good ore. M. V. Eardley, of Carthage, manager.

R. E. LAUCK (Kansas City)—Has taken lease on 260-acre tract near Afton, Okla., and will put drills at work immediately.

JESSE SHORT (Joplin)—Disposed of three leases on recently acquired 120-acre tract of Scott land for $99,000. One 40-acre lease to Golden Eagle Mining Co., which has started shaft sinking. Short retains lease for Sequoyah company, which has shaft down 85 ft. Expect to get to ore by middle February; new mill, 250 ton capacity, already completed.

CLIFFWOOD (Carthage)—Good ore shown by drill holes in new territory 6 mi. northwest of Carthage. B. L. Van Hoose, Carthage, interested. Shaft now being sunk. Ore at 140 to 160 ft.

ARROW (Aurora)—The 150-ton mill from Alba, Mo., rebuilt on this lease, north of Red Wasp property. Ore at 135, 175 and 215 ft.

MONTANA

Silver Bow County

EAST BUTTE (Butte)—January copper production estimated at 1,479,500 lb.

DAVIS-DALY (Butte)—Orebody opened Jan. 9 on 2400 level still being drifted on; 9½ ft. wide, containing glance and bornite; 50 mine cars ordered.

TUOLUMNE MINING (Butte)—December shipments from Main Range amounted to about 450 tons, netting over $4000. Production at Tuolumne mine proper for January will be 3500 tons. Sinking to the 2800 and 3000 levels will be resumed soon.

GREAT BUTTE COPPER CO. (Butte)—Repairs to Calumet shaft completed and 300-gal. steam pump installed on 1000-ft. level. Shaft now down 1027 ft., will be continued to 1500 level. Shaft is about 6000 ft. northeasterly from Butte & Superior's Black Rock mine. Property consists of 272 acres of mineral land, formerly controlled by the Butte & Bacorn company.

BUTTE & SUPERIOR (Butte)—January zinc production estimated at 13,000,000 lb., a decrease of about 2,500,000 lb. from December. Milled only 49,000 tons of ore as against 57,140 in December. Decrease due to cold weather, fire in shaft and experimentation in mill with flotation processes. The fire, which occurred Jan. 26 on the 150-ft. level of the Black Rock mine for a time threatened to cause a serious situation. Due to prompt efforts of fire fighters of the Butte & Superior and Anaconda companies, blaze was brought under control before it could communicate to other levels; the damage to the shaft was comparatively small and was quickly repaired. This was the first underground fire in the Black Rock. It appears that the fire was started from a torch left burning at the 150 station. As soon as discovered the underground men were brought to the surface through the auxiliary shaft as a matter of precaution and one day and night shift laid off; mill continued operations. Hoist for new No. 2 shaft has been shipped. When installed, company will be in position to increase output, having two hoisting shafts to depend on hereafter instead of one. The hoist is expected to be ready for operation the latter part of May. Planned to sink shaft to 2000 level and then crosscut.

NEVADA

Esmeralda County

GREAT BEND (Goldfield)—Ore of commercial grade over a 4-ft. width opened on 260-ft. level.

ATLANTA (Goldfield)—Manager A. I. d'Arcy reports gold-silver-copper ore in north drift at the 1750-ft. level; where opened vein was 6 ft. wide.

JUMBO EXTENSION (Goldfield)—Drift on 880-ft. level recently opened 4 ft. of $40 ore. This with pillars being mined in old stopes is expected to meet cost of present development. Core drilling recently started on 1017-ft. level.

GOLDFIELD CONSOLIDATED (Goldfield)—Net realization for December from 26,000 tons was $16,441. Operating costs per ton milled were: Mining $2.22; transporting, including moving of tailing, 12c.; milling, $1.74; marketing, 3c.; general expense 43c.; bullion tax 1c.; filter royalty 3c.; flotation royalty 5c.; surface 4c.; total operating costs, $4.67; misc. earnings 8c.; net operating costs $4.59.

Nye County

TONOPAH ORE PRODUCTION for week ended Jan. 27 was 9266 tons of an estimated value of $166,788, comparing with an output of 9396 tons for the previous week. Shippers were: Tonopah Belmont, 2873 tons; Tonopah Extension, 2380; Tonopah Mining, 1750; Jim Butler, 1050; West End, 697; Rescue, 192; Halifax, 208; MacNamara, 52; Midway, 43; miscellaneous, 21 tons.

JIM BUTLER (Tonopah)—December net profit $22,508 from 2601 tons of ore shipped to Belmont plant at Millers.

TONOPAH BELMONT (Tonopah)—December net profit $114,835.51 from 10,204 tons of ore. Bullion production 2159.11 oz. gold and 205,174 oz. silver.

Lincoln County

SHIPMENTS FROM PIOCHE amounted to 76 cars, for week of Jan. 27, as follows: Prince Con., 60 cars; Nevada-Utah (concentrates), 2; Hodges Cook Mercantile Co., 2; Hamburg Mines, 1; Uvada Copper, 8; E. H. Snyder (slag), 2; Crippe & Co., 1 car.

ATLANTA HOME (Atlanta)—Allen Hastings Rogers recently examined this gold property; mill contemplated.

White Pine County

NEVADA CONSOLIDATED (McGill)—December copper output 7,174,415 lb.; total for 1916 was 90,831,000 lb.; 1915 output 62,726,651 lb.

CONSOLIDATED COPPERMINES (Kimberly)—Coal shortage delaying start of additional sections of 500-ton mill. Properties recently inspected by Directors Humphreys, Burgess and Merritt, in company with Oscar Rohn, general manager of East Butte Copper Mining Co. Charles H. Boynton, who has been president of the Coppermines company during the past two years of its regeneration, has resigned because of prospective absence in Russia; no successor named; Albert E. Humphreys of Denver, who has been active in the recent financing, will act as chairman of the board.

NEW MEXICO

Grant County

CHINO (Hurley)—December copper output 6,750,916 lb.; total for 1916 was 75,551,000 lb.; 1915 output was 64,887,788 lb.

LAWRENCE MINING (Lordsburg)—This company has purchased the Bonney mine from Western Mining and Development Co. Guilford A. Deitch, of Indianapolis, is president; Oliver Powers, superintendent.

TENNESSEE

TENNESSEE COPPER (Copperhill)—Suit entered against this company and National Surety Co. in Federal court in New York by Russian government for $1,140,000 advanced on trinitrotoluol purchase.

TEXAS

Brazoria County

FREEPORT SULPHUR (Freeport)—No. 4 "steaming" plant nearly completed; should be placed in operation soon increasing sulphur output about one-third.

Reeves County

MICHIGAN SULPHUR AND OIL (Orla)—This company, late in January, was loading its first car of sulphur for shipment.

TOYAH VALLEY SULPHUR (Houston)—Expects to install sulphuric-acid works as well as a mining plant at its property near Orla in Reeves County. Joseph A. Daniel, secretary.

UTAH

Beaver County

ANTELOPE STAR (Milford)—Galena ore 1 ft. thick in south tunnel at intersection of fissure with limestone. A. C. Nebeker, superintendent.

MINERAL RANGE (Milford)—First shipment of ore from this property showed control assays of 15% lead, 8.8 oz. silver, 6.5% iron, and 30c. gold. Vein 4 ft. wide. J. L. Craig, manager.

EAST ANTELOPE (Milford)—Drifting being done to reach limestone-quartzite contact. Copper ore up to 18 in. wide, opened along footwall of southwest fissure. L. McLease, superintendent.

Juab County

EUREKA MINES (Eureka)—Selling 200,000 shares treasury stock to obtain funds for development. Being explored through the Gemini.

YANKEE (Eureka)—New crosscut tunnel being driven to reach recently developed silver-lead-gold oreshoot. Will facilitate handling of ore and waste.

LOWER MAMMOTH (Mammoth)—Report for 1916 shows receipts of $39,207; control lately acquired by Knight interests; new directorate comprises: Jesse Knight, president; John Dern, J. W. Knight, W. L. Mangum, A. Reeves, R. E. Allen, F. D. Kimball and K. S. Jordan.

MAMMOTH (Mammoth)—Copper-silver ore being mined from recent strike on 400 level about 1000 ft. northeast of main shaft. Total mine output about 20 cars a week, ore coming from 400 to 1600 levels. Arrangements made to market large dump. About 130 men employed.

IRON BLOSSOM (Silver City)—Raise to be driven from 1700 to connect with winze from 1300 level in copper orebody. When completed ore will be dropped to 1700 for hoisting from No. 1 shaft. Copper orebody opened on three levels. Not yet stoped, awaiting better arrangements for handling ore.

SIOUX (Eureka)—Shaft being sunk under contract, by Duncan & Allen, now down to 900 level and to be continued to 1000 level. Station cut on 800 and drifting to be done on this and 1000 as soon as latter level is reached. Prospecting being done in search of continuation of copper orebody opened in north end of Iron Blossom. Most of Sioux ore has been silver-lead, coming from above 600.

COLORADO CONSOLIDATED (Silver City)—Main shaft down 1700 ft.; being sunk under contract to Walter Fitch, Jr. Sinking to be continued to 2000 ft. or possibly water level. To be deepest shaft on east of Colorado-Iron Blossom-Sioux ore zone. Iron Blossom shaft down 1900 ft., and Yankee shaft, 2000 ft. Largest orebodies in former Colorado oreshoot found above 250 level. Lessees working extensively.

Salt Lake County

MONTANA-BINGHAM (Bingham) — Special meeting called for Feb. 15 to consider increasing capitalization to 3,000,000 shares. W. E. Hubbard, president.

UTAH FERTILIZER & POTASH (Salt Lake)—Quit claim deed filed for record at Provo to this company for six claims in Lehi mining district, between Pelican Point and Monda, on west side of Utah Lake.

Summit County

NEW QUINCY (Park City)—Car of ore lately marketed from east and west drifts on 280 level, above the Daly West 900.

KEYSTONE (Park City)—E. O. J. Hanke, who has been associated with the Daly Judge, has acquired interest in this property, and has been made a director.

Utah County

GOLD HILL (American Fork)—Lower tunnel in 175 ft. and has cut vein opened in No. 2 tunnel. Ore carries copper, silver and gold. Tunnel gives depth of 200 ft. on vein.

BIG NEBO (Provo)—Drifting near face of 800-ft. tunnel in rock mineralized with galena and pyrite. Property in Santaquin district. W. F. Giles, manager.

GLOBE (American Fork)—Work to be resumed as soon as weather permits. Tunnel in 400 ft., and some mineralization encountered. Claims between Belerophon and Earl-Eagle.

CANADA

Ontario

KENABEEK (Auld Township)—Reopened; shaft down 92 ft. on vein.

McRAE (Porcupine)—Offering 200,000 shares of treasury stock at 50c. for further development.

O'CONNOR CLAIMS near Nellie Lake, a short distance north of Porquis Junction, which show a vein carrying nickel on the surface, are being diamond drilled.

GOLD REEF—(Porcupine)—Drifting at depth of 35 ft. encountered 3-in. vein of high-grade ore, with good gold content in wall rock for 12 in. on each side.

SCHUMACHER—(Schumacher)—Large vein recently tapped at 200-ft. level 22 ft. in width; ore of fair grade. Crosscutting north from 200-ft. level of No. 4 shaft.

KIRKLAND LAKE (Kirkland Lake)—Shaft down 470 ft. At 300-ft. level fair ore obtained for width of 42 ft.; richer at the 400 level. When 500-ft. depth is reached another crosscut will be driven to the vein. Stated that Beaver Consolidated will exercise its option.

HOLLINGER CONSOLIDATED—(Timmins)—Report for four-week period ended Dec. 31, showed profits of $225,057, from the treatment of 49,106 tons of ore; average value $8.49; working cost $3.70 per ton milled. Mill only ran 85.3% of possible running time. Operating profits for year were $2,866,984; current and gold assets at end of year were $981,263; current liabilities of $425,211. During December the company received $180,000 in premiums on new stock issue and deficit existing since the merger was reduced to $79,015.

COSTA RICA

AGUACATE MINES (San Mateo)—Black vein of Quebrada Honda mine lately opened on 850 level for about 200 ft.; stoping will be started soon as new equipment is installed; ore will be hoisted to seventh level, mill being situated at mouth of seventh-level tunnel; station will be cut at 925-ft. level of interior shaft and crosscutting started to Black vein. In Oreamunos group, company reports opening two of the old rich shoots. P. G. Spilsbury, manager.

CHILE

BRADEN (Sewell)—January copper production estimated at 4,798,000 lb.

AUSTRALIA

ELECTROLYTIC ZINC CO. OF AUSTRALIA (Melbourne)—Construction of electrolytic zinc plant near Hobart, Tasmania, begun Jan. 8. First unit expected to be ready for operation about end of July.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—January cleanup, reported by cable, $152,305; ore milled above average grade.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Feb.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
1	4.7575	76⅜	37 7/16	5	4.7575	76⅞	37⅜
2	4.7575	76⅜	37 7/16	6	4.7569	77	37 7/16
3	4.7575	76⅜	37⅜	7	4.7556	77⅛	37⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	30		8	7.90	9¼
1	@31	49	@8½	@8.20	@9½
	30		8	8.00	8½
2	@31	51	@8½	@8.20	@9½
	*30		8	8	8½
3	@31	51	@8½	@8½	@9½
	*30		8	8	9¼
5	@31	55	@8½	@8½	@9½
	*30		8	8	9¼
6	@31	55	@8½	@8½	@9½
	*30		8	8	9¼
7	@31	55	@8½	@8½	@10

* Nominal.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies; and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Feb.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
1	134	130	145	195½	196½	30½	47
2	134	130	145	199½	200½	30½	47
3							
5	134	130	145	200½	201½	30½	47
6	136	132	145	202½	203½	30½	47
7	137	133	146	201	202	30½	47

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 643c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

NEW YORK—Feb. 7, 1917

During such a historic week, fraught with uncertainties, it was only to be expected that irregularities and uncertainties would be exhibited in the metal markets. In copper there was a deadlock. In tin, a sharp advance. Lead was strong with only a slight advance. Spelter declined sharply and experienced an equally sharp recovery.

Copper, Tin, Lead and Zinc

Copper—On Feb. 1 and 2 some round lots for February-June delivery were reported sold at 30½@30¾c., net cash, New York. Subsequent to that we had reports of no transactions and quote the market nominally at the last figures. There is a large demand for copper for February-April delivery, but no producer is able to furnish it, or if he can put his hands on a little, he desires to couple it with later deliveries. There is no longer any copper offered for resale, and brokers are therefore out of business. If a stray lot of 25 or 50 tons for prompt delivery turns up a fancy price can be obtained for it—we have heard of 34c. being done—but even of such business scarcely any is now reported. On the other hand, nobody wants to buy copper for the delivery that producers can supply, viz., July and later. The situation is, therefore, that the copper that is wanted cannot be supplied and the copper that can be supplied is not wanted. What will be the relief from this situation remains for the future to show. At present, it looks as if inability to deliver copper already sold, owing to traffic difficulties, may develop into a determinative factor.

Shattuck Arizona Copper Co. is the first one to report average prices for 1916. Its average for copper delivered was 23.18c. per lb., while for copper sold it was 27.177c. per lb., these being gross prices in each case.

Copper Sheets—Base price for copper sheets continues unchanged. The quotation is 42c. for hot rolled and 43c. for cold rolled. Wire is quoted on a base of 37c. f.o.b. mill.

Tin—Following the news of the new German policy on Feb. 1, the tin market became very excited and advanced sharply on large transactions.

Lead—This metal is in somewhat the same position as copper, viz., producers are practically sold out for early deliveries—February and March. However, the situation in this respect is less acute than in the case of copper, for numerous sales of 100 and 200-ton lots for February or March delivery, or the two months combined, were reported, and the aggregate of these amounted to a fair total. There was a good deal of variation in prices reported realized, especially in the early part of the week, this probably reflecting the exigencies of individual buyers, the chances of getting the lead carried, etc. On the whole, however, there was some slackening of inquiry in the early part of the week, following receipt of the German note, and there were even some intimations that consumers might resell February lead at 8c. The whole complexion of things changed, however, on Feb. 5 along with the turn in other markets. Throughout the week, the principal producer maintained its price at 8c., New York, and in conformity with its previous policy took care of its regular customers at that price.

The British ministry of munitions ordered that from Feb. 2, except for the execution of existing contracts, no person shall deal in lead except under license. Within 10 days all persons shall report holdings of lead purchased for future delivery, amount of deliveries in January, and all contracts existing in January. Until further notice, lead may not be used except for repairs and in quantities under 1 cwt., except under license. This order includes pig, sheet, pipe and scrap.

Spelter—The decline in this metal which was going during the latter part of our last week of record was precipitated on Feb. 1, when business for February delivery was done at 9¾c. early in the day and at 9¼c. toward the close. There was further weakness the next day. On Feb. 5 the change in other markets was reflected in this and business was done at an advance. On Feb. 6 there was more business reported than in any day for a long time and the good demand at advancing prices continued on Feb. 7. The demand was partly from dealers, but was largely from consumers, including galvanizing, and the market had a healthier look than for a long time. This was reflected in the business of Feb. 6 which was done for a wide range of deliveries at but little variation in price.

Zinc—Butte & Superior produced 13,000 tons of concentrates in January, compared with 14,190 tons in December.

Zinc Sheets—No change has been made in the market price of zinc sheets. Quotation is $21 per 100 lb., f.o.b. Peru, less 8% discount.

Other Metals

Antimony—In our report last week we said, "Sales were made as high as 25c. and today 26c. is quoted." It was the intention to say that antimony was offered at 26c. then, but sales of which we had reports were at 25c. and our quotation is 25c. During the last week there was a further stiffening in the antimony situation, but the business reported was only for small lots, the market being practically bare of stocks, with quotations only nominal. We quote 26@28c. February-March shipment from China is quoted nominally at 14@15c., c.i.f., New York, duty unpaid, but the large producers have withdrawn from the market, wherefore, that quotation also is of doubtful significance. The antimony market, like some others, is for the moment uncertain.

Aluminum—The aluminum market continues quiet, with buyers scarce. Nominal quotations are at 58@60c. per lb. for No. 1 ingots, New York.

Calcium—Silicate unchanged at $1.

Cerium—The iron alloy is firm at $28 for long sticks or cut pieces.

Nickel—No change appears in nickel quotations. Price remains at 45@50c. per lb., with electrolytic commanding an additional 5c.

Quicksilver—In the absence of stocks in this market there was a further advance in price, business having been done at $100 per flask, which we quote as the market. San Francisco reports, by telegraph, $85, firm.

Gold, Silver and Platinum

Silver—Silver has shown some improvement in price owing in a measure to the tardy arrival of supplies en route to London. Shipping facilities somewhat restricted. The only steady purchaser continues to be the British Mint. The market in China has been strong and exchange rates in Shanghai have been quoted above par.

Mexican dollars at New York, Feb. 1, 59¼@62¼c.; Feb. 2, 59¼@62¼c.; Feb. 3, 59¼@62¼c.; Feb. 5, 59⅝@62⅝c.; Feb. 6, 59⅝@62⅝c.; Feb. 7, 59¾@62¾c.

Platinum—Demand from the jewelry trade continued, with result of a further advance in price. We quote $100@105.

Our Petrograd correspondent reports under date of Nov. 24, 1916, no change in the platinum situation. Platinum is taken over by the government at a price of $70.56 to $72.52 per troy ounce of crude platinum carrying 83% pure metal, the exact figure not having been yet determined. Small amounts required by jewelers or for technical purposes are supplied by the State Bank, after having secured government permission.

Palladium—Quoted at $85.

Zinc and Lead Ore Markets

Platteville, Wis., Feb. 3—Blende, basis 60% Zn, medium grade $72. Fancy ores command a premium and low-grade ores sell at a discount. Lead ore, basis 80% Pb, $95@100.

Shipments for the week ended Feb. 3 were 2578 tons of zinc ore; 55 tons of lead ore and 625 tons of sulphur ore. For the year to date the figures are 12,924 tons of zinc ore; 402 tons of lead ore and 2507 tons of sulphur ore. Shipped during week to separating plants, 3508 tons zinc ore.

Joplin, Mo., Feb. 3—Blende, basis 60% Zn, medium grade, $70@80. Fancy ores realize a premium and low-grade ores sell at a discount. Calamine, basis 40% Zn, $50@55. Average selling price all grades of zinc ore, $84.46 per ton.

Lead ore, basis 80% Pb, $96@100. Average selling price all grades of lead ore, $95.09.

Shipments the week: Blende, 7937 tons; calamine, 305 tons; lead, 1323 tons. Value, all ores the week, $795,440.

Demand slumped to a shadow of what it was last week, the shipment being from last week's purchases. German submarines put one over on this, as many other markets, so far as blende is concerned, but no drop was reported today in calamine or lead prices.

Three days of zero weather, with consequent gas shortage, brought the usual restriction of output of blende, and all the mines producing calamine on hand-jigs were incapacitated during all the week since Tuesday.

Other Ores

Antimony Ore—Business was done at $1.85 per unit.

Chrome Ore—The 40% ore is firm at $1 per unit. Inquiries numerous.

Molybdenum Ore—The 90% sulphide has become stronger, nothing being offered except from South America and the Orient, and then only in odd lots. Molybdate of lead, used to substitute the sulphide in producing ferromolybdenum, firm at $4.

Charles Hardy reports under date of Feb. 6 as follows: "Foreign buyers are in the market to

secure not only prompt supplies but also contracts for forward delivery, and if a reliable supply can be obtained, the question of price could be easily overcome. The market continues nominally at $1.80 per lb. for 90% concentrates."

Tungsten Ore—We quote this market unchanged at $17 per unit.

Charles Hardy reports under date of Feb. 6: "During the latter part of last week hardly any business was done in tungsten on account of the uncertainty in the political situation. The actual announcement of the break (with Germany), however, found the market swamped with inquiries from all quarters and considerable business was done on Feb. 5 for immediate delivery from stock New York, at $17. Just now spot material, New York, is very much in preference on account of the heavy congestion of traffic in the West. Material which left Western points in December has not yet reached the factories and it is even difficult to locate the cars. Anything that can be delivered at a moment's notice in the East would even obtain a premium. Besides our home market, England, France and Italy appeared on Feb. 5 as buyers for considerable quantities and only the difficulties of securing freight have so far prevented the business being consummated."

Iron Trade Review

NEW YORK—Feb. 7

It is too early, according to "Iron Age" to measure the effect on the iron and steel trade of Germany's unrestricted submarine warfare. The railroads have been the clogging defile in the path from mill to ship, and for a long time exporting has been embarrassed more by the chaos in rail transportation than by the scarcity of vessels.

The war buying by the United States Government now at last becomes definite after months of reservation by mills and ordnance makers. Pushing warship material for early rollings may tend to disturb other plate deliveries, but shell-steel demand is not likely to be heavy until we have something with which to shoot it. Active negotiations are now under way for big additions to our artillery equipment.

PITTSBURGH—Feb. 6

A blizzard struck the Pittsburgh district, and the Central West generally, on Sunday, temperatures falling below zero. Natural gas was shut off largely from the few mills still using it and various other inconveniences were suffered, all cutting down production. Car supplies throughout the industry were much reduced. The Connellsville coke region is likely to ship less than one-half the coke required and pig iron production in the tributary region, nearly one-half the iron industry will be correspondingly reduced. More than a score of blast furnaces were already banked, and additional stacks are being banked daily. The third of the five Lorain furnaces, for instance, was banked yesterday. Steel mills have been drawing upon their reserves of scrap and pig iron, which promise to prove altogether inadequate if the coke shortage continues very much longer.

The steel market has not been definitely affected by the break with Germany or the definite prospect of more serious developments to follow. Naturally there is reduced inquiry, but there are no cancellations or suspensions and buyers are exerting at least as much pressure as formerly for better deliveries of steel. The present reduction in shipments will probably result in increased pressure.

At the outside, rush orders for steel for war preparations would not represent more than say 15 to 25% of the steel-making capacity. This would be obtained by delaying shipments of commercial steel ordered, not by curtailing supplies to those already fighting Germany. The steel mills are all ready to enter rush orders for war preparation, irrespective of price. The chief inconvenience would fall upon domestic consumers.

While steel producers feel that war conditions would tend to advance prices, they have no thought of advancing prices at this time and possibly would welcome Government regulation of prices. How much steel can be shipped for export in future is purely a matter of conjecture. There may be a reduction but the considerable reduction that has occurred since the September maximum has been accompanied by increasing scarcity of steel for domestic use.

Pig Iron—There is increased inquiry for prompt foundry iron on account of curtailed production and embargoes on shipments. A fresh demand for prompt basic has arisen. There is no market for late deliveries. The northern furnaces if called upon to quote would quote their prompt prices, which are out of the question, as Southern iron, in foundry grades at least, could be had for many dollars a ton less. We quote prompt as follows: Bessemer, $35; basic, $30; foundry and malleable, $33@35; forge, $32@34, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh. When there was a real market on second-half foundry iron it was $30, valley.

Steel—There is practically nothing to be had. Last quotations were about $65 for bessemer or openhearth billets or sheet bars.

STOCK QUOTATIONS

N. Y. EXCH.†	Feb. 6
Alaska Gold M.	7⅛
Alaska Juneau	7⅛
Am.Sm.&Ref.,com	99
Am. Sm. & Ref., pf.	114½
Am. Sm. Sec., pf. A	99
Am. Sm. Sec., pf. B.	97
Am. Zinc	36½
Am. Zinc, pf.	67
Anaconda	76½
Batopilas Min.	1½
Bethlehem Steel	415
Bethlehem Steel, pf.	120
Butte & Superior	46
Chile Cop.	22⅛
Chino	54½
Colo.Fuel & Iron	44½
Crucible Steel	68
Dome Mines	21
Federal M. & S.	11⅛
Federal M. & S., pf.	36½
Great Nor., ore ctf.	32½
Greene Cananea	45
Homestake	125
Inspiration Con.	56½
International Nickel	44⅛
Kennecott	44⅛
Lackawanna Steel	78⅛
Miami Copper	36½
Nat'l Lead, com.	56½
National Lead, pf.	110
Nev. Consol.	24½
Ontario Min.	5
Quicksilver	2
Quicksilver, pf.	2½
Ray Con.	26
Republic I.&S.,com.	77⅛
Republic I. & S. pf.	102
Sloss-Sheffield	62
Tennessee C. & C.	14½
U. S. Steel, com.	107⅛
U. S. Steel, pf.	117⅛
Utah Copper	108⅛
Va. Iron C. & C.	47½

N. Y. CURB†	Feb. 6
Buffalo Mines	1.60
Butte & N. Y.	1½
Butte C. & Z.	9⅛
Caledonia	.52
Can. Cop. Corpn.	1½
Carlisle	5½
Cashboy	.06
Cerro de Pasco	37⅛
Con. Ariz. Sm.	2½
Con. Coppermines	3⅛
Con. Nev.-Utah	⅜
Crystal Cop.	1⅞
First Nat. Cop.	3
Florence	‡.70
Goldfield Con.	.64
Goldfield Merger	.09
Granite	.12
Hecla Min.	7½
Howe Sound	6⅛
Jerome Verde	1½
Joplin Ore & Spel.	.34
Kerr Lake	4½
Magma	45
Majestic	⅛
McKinley-Dar-Sa.	.50
Mother Lode	.41
Nevada Hills	.20
N. Y. & Hond.	13½
Nipissing Mines	7½
Ray Hercules	4½
Rochester Mines	.56
St. Joseph Lead	19
Standard S. L.	⅛
Stewart	.25
Success	.35
Tonopah	5½
Tonopah Ex.	3⅛
Tribullion	1⅞
Troy Arizona	.53
United Verde Ext.	35
United Zinc	3
White Knob, pf.	1½
White Oaks	2
Yukon Gold	2

SAN FRAN.*	Feb. 6
Alta	.03
Andes	.17
Best & Belcher	.03
Bullion	.02
Caledonia	.18
Challenge Con.	.04
Confidence	.10
Con. Virginia	.05
Gould & Curry	.04
Hale & Norcross	.06
Jacket-Cr. Pt.	.04
Mexican	.15
Occidental	.65
Ophir	.10
Overman	.03
Savage	.06
Seg Belcher	.02
Sierra Nevada	.15
Union Con.	.44
Utah Con.	.01
Belmont	4.30
Jim Butler	.70
MacNamara	.06
Midway	.17
Mont.-Tonopah	.17
North Star	.13
Rescue Eula	.22
West End Con.	.63
Atlanta	.14
Booth	.11
Comb. Frac.	.05
D'field B.B.	.03
D'field Daisy	.04
Florence	.24
Jumbo Extension	.30
Kewanaa	.15
Round Mountain	.42
Silver Pick	.17
Argo	.06
Ariz. Central	.10
Big Jim	1.06½
Lazy Boy	.06
Nellie	.18
Tom Reed	1.75
United Eastern	4.37½
United Western	‡.02

BOSTON EXCH.*	Feb. 6
Adventure	3¼
Ahmeek	99
Algomah	1
Allouez	62
Ariz. Com., ctfs.	13
Bonanza	‡.35
Butte-Ballaklava	1⅛
Calumet & Ariz.	78⅝
Calumet & Hecla	541
Centennial	21
Copper Range	62½
Daly West	2½
East Butte	13⅜
Franklin	7⅞
Granby	80½
Hancock	17
Hedley	17
Helvetia	.40
Indiana	2½
Island Cr'k, com.	63
Isle Royale	33
Keweenaw	4
Lake	13½
La Salle	‡4½
Mason Valley	5½
Mass	13
Mayflower	2½
Michigan	3
Mohawk	81
New Arcadian	4
New Idria	14½
North Butte	21¼
North Lake	2
Ojibway	2½
Old Colony	2½
Old Dominion	60⅛
Osceola	83½
Quincy	88
St. Mary's M. L.	80
Santa Fe	1⅛
Shannon	8½
Shattuck-Ariz.	26½
So. Lake	4½
So. Utah	‡.28
Superior	13½
Superior & Bost.	6⅛
Tamarack	54½
Trinity	4½
Tuolumne	1½
U. S. Smelting	57
U. S. Smelt'g, pf.	51
Utah Apex	2⅛
Utah Con.	18
Utah Metal	5
Victoria	5
Winona	4½
Wolverine	49
Wyandot	1½

BOSTON CURB*	Feb. 6
Alaska Mines Corp.	1½
Bingham Mines	7⅞
Boston Ely	.45
Boston & Mont.	.67
Butte & Lon'n Dev.	.18
Calaveras	4½
Calumet-Corbin	1½
Chief Con.	1⅞
Cortez	.25
Crown Reserve	.35
Davis-Daly	5½
Eagle & Blue Bell	1½
Houghton Copper	1½
Iron Cap Cop., pf.	17½
Mexican Metals	.31
Mines of America	1⅛
Mojave Tungsten	.90
Nat. Zinc & Lead	.50
Nevada-Douglas	1⅞
New Baltic	2½
New Cornelia	16½
Ohio Copper	.60
Oneco	.85
Pacific Mines	.35
Rex Cons.	.34
Rilla	.03

SALT LAKE*	Feb. 6
Big Four	.87
Black Jack	.08
Cardiff	5.00
Colorado Mining	.17
Crown Point	.04
Daly-Judge	8.60
Emma Cop.	1.62½
Empire Copper	1.90
Gold Chain	.15
Grand Central	.50
Iron Blossom	1.25
Lower Mammoth	.04½
May Day	.09½
Moscow	.16
Prince Con.	1.20
Seven Troughs	‡.04
Silver-King Coal'n	3.10
Silver King Con.	4.10
Sioux Con.	.12
So. Hecla	1.35
Uncle Sam	.04
Wilbert	.12½
Yankee	.11

TORONTO*	Feb. 6
Bailey	.05
Beaver Con.	.44
Chambers Ferland	.14
Coniagas	4.10
La Rose	.50
Peterson Lake	.10
Right of Way	.05
T. & Hudson Bay	59.50
Temiskaming	.56
Wettlaufer-Lor.	.07
Dome Exten.	.28
Dome Lake	.35
Foley O'Brien	.70
Hollinger	6.50
Jupiter	.29
McIntyre	1.81
Newray	1.15
Porcu. Crown	.66
Schumacher	.66
Vipond	.46
West Dome	.30

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Feb. 6
Cresson Con.	6.75
Doctor Jack Pot.	.08½
Elkton Con.	.12
El Paso	.30
Findlay	.05½
Gold Sovereign	.05
Golden Cycle	2.45½
Granite	.58
Isabella	.20
Mary McKinney	.25
Portland	1.89
Vindicator	1.12

LONDON	Jan. 22
Alaska Mexican	£0 12s 6d
Alaska Tre'dwell	2 10 0
Burma Corp.	3 18 9
Cam & Motor	0 9 9
Camp Bird	0 5 9
El Oro	0 7 0
Esperanza	0 8 6
Mexico Mines	4 2 6
Nechi, pfd.	0 12 3
Oroville	0 15 0
Santa Ger t'dis	0 8 6
Tomboy	1 0 0

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755		22.753	26.975	
March	50.241	57.935		23.708	27.597	
April	50.250	64.415		23.709	30.662	
May	49.915	74.269		23.570	35.477	
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.265		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan.	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440		102.667		133.167	
Mar.	26.310		107.714		136.000	
April	27.895		124.319		137.389	
May	28.625		135.457		152.522	
June	26.601		112.432		137.455	
July	23.865		95.119		125.500	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct.	27.193		122.750		142.523	
Nov.	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717		181.107	
March	50.741		193.609	
April	51.230		199.736	
May	49.125		196.511	
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av. year	43.480		182.096	

Lead	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246		6.164		31.988	
March	7.136		7.375		34.440	
April	7.630		7.655		34.368	
May	7.463		7.332		32.967	
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.858		6.777		31.359	

Spelter	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
Jan.	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420		18.260		97.762	
Mar.	16.846		16.676		95.048	
April	16.695		16.525		99.056	
May	14.276		14.106		94.217	
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept.	8.990		8.820		52.095	
Oct.	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ⅛ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1917	1917	1917	1917
January	$21.60		$18.78		$19.70	
February	21.16		18.93		19.51	
March	21.81		19.20		19.45	
April	21.65		18.95		19.45	
May	21.78		19.11		19.58	
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.

Mining Companies—United States

Name of Company and Situation		Shares		Dividends		
		Issued	Par	Total	Latest	Amt.
Ahmeek, c	Mich	200,000	$25	$6,850,000	Jan. '17	$4.00
Alaska Mexican, g	Alas	180,000	5	3,507,381	Nov. '15	0.10
Alaska Treadwell, g	Alas	200,000	25	15,785,000	May '16	0.50
Alaska United, g	Alas	180,200	5	2,045,270	Feb. '16	0.30
Allouez, c	Mich	100,000	25	1,050,000	Jan. '17	3.00
Am. Sm. & Ref., com	U. S.	501,080	100	32,131,048	Dec. '16	1.50
Am. Sm. & Ref., pf	U. S.	500,000	100	58,296,386	Dec. '16	1.75
Am. Smelters, pf. A	U. S.	166,498	100	11,933,282	Jan. '17	1.50
Am. Smelters, pf. B	U. S.	300,000	100	17,385,000	Jan. '17	1.25
Am. Zinc, Lead & Sm	U. S.	228,120	25	1,108,820	Apr. '13	0.50
Anaconda, c	Mont	2,331,250	50	117,891,875	Nov. '16	2.00
Argonaut, g	Calif	200,000	5	1,780,000	Dec. '16	0.10
Arizona Copper, com	Ariz	1,519,896	1.20	18,477,482	July '16	0.36
Arizona Copper "A," pf	Ariz	160,000	1.20	253,564	Oct. '16	
Arizona Copper, pf	Ariz	1,266,120	1.20	1,994,720	Nov. '16	
Baltic, c	Mich	100,000	25	7,950,000	Dec. '13	2.00
Barnes-King, c	Mont	400,000	5	60,000	June '16	0.075
Bingham N. H., c	Utah	228,689	5	960,493	Dec. '15	0.05
Bonanza Dev., g	Colo	300,000	1	1,425,000	Oct. '11	0.20
Brunswick, g	Calif	395,287	1	203,315	Sept. '15	0.06
Bunker Hill Con., g	Calif	200,000	1	876,000	Nov. '16	0.02½
Bunker Hill & Sul., l.s	Ida	327,000	10	18,653,250	Jan. '17	0.50
Butte-Alex Scott, c	Mont	79,311	10	1,054,119	Apr. '16	10.50
Butte-Ballaklava, c	Mont	250,000	10	125,000	Aug. '10	0.50
Butte & Superior, z	Mont	290,197	10	15,010,486	Dec. '16	6.25
Caledonia, l.s.c	Ida	2,605,000	1	1,872,631	Jan. '17	0.03
Calumet & Arizona, c	Ariz	642,378	10	28,925,269	Dec. '16	3.00
Calumet & Hecla, c	Mich	100,000	25	136,750,000	Dec. '16	25.00
Camp Bird, g.s	Colo	1,100,051	5	9,750,836	Nov. '15	0.24
Cardiff, l z	Utah	500,000	1	500,000	Dec. '16	0.25
Centennial, c	Mich	90,000	25	90,000	Sept. '16	1.00
Centen'l-Eur., l.s.g.c	Utah	100,000	5	4,150,000	Apr. '16	1.00
Center Creek, l.z	Mo	100,000	10	615,000	Dec. '16	0.10
Champion, c	Mich	100,000	25	17,960,000	Dec. '16	6.40
Chief Consolidated, s.g.l	Utah	883,020	1	527,518	Nov. '16	0.05
Chino, c	New Mex	869,980	5	13,875,330	Dec. '16	2.50
Cliff, g	Utah	300,000	1	90,000	Jan. '13	0.10
Cliff, g	Alas	100,000	1	210,000	Oct. '13	0.01
Colo. Gold Dredging	Colo	100,000	10	775,000	Feb. '16	1.00
Colorado, l.s.g	Utah	1,000,000	0.20	2,570,000	Dec. '12	0.03
Commercial Gold	Ore	1,661,000	1	366,350	Oct. '16	0.00½
Cons. Inter. Callahan l.z	Ida	464,990	10	5,347,385	Dec. '16	1.50
Continental, z.l	Mo	22,000	25	594,000	Jan. '17	0.50
Copper Range, c	Mich	394,001	25	19,108,758	Dec. '16	3.50
Cresson Con	Colo	1,220,000	1	4,343,162	Jan. '17	0.10
Daly West, s.l	Utah	180,000	20	6,606,000	Jan. '13	0.15
Doctor Jackpot, g	Colo	3,000,000	0.10	141,699	Jan. '17	0.01
Doe Run, l	Mo	65,749	100	3,550,969	Dec. '13	0.76
Eagle & Blue Bell, g.s.l	Utah	893,146	1	535,887	Dec. '16	0.05
Elkton Con., g	Colo	2,500,000	1	3,579,460	May '15	0.02
El Paso, g	Colo	490,000	5	1,707,545	Feb. '14	0.10
Ernestine, g.s	N.M	300,000	5	150,000	July '15	0.10
Fed. M. & S., com	Idaho	60,000	100	2,708,750	Jan. '09	1.50
Fed. M. & S., pf	Idaho	120,000	100	13,086,795	Dec. '16	1.25
Florence, g	Nev	1,050,000	1	840,000	Apr. '11	0.10
Fremont Con., g	Calif	200,000	2.50	258,000	Oct. '14	0.02
Frontier, z	Wis	1,250	100	146,202	Nov. '13	2.00
Gemini, l.g.s	Utah	5,000	100	2,435,000	Dec. '16	6.00
General Dev	U. S.	120,000	25	3,683,917	Dec. '16	1.50
Gold Chain, g	Utah	1,000,000	1	130,000	May '13	0.03
Gold Dollar Con	Colo	2,500,000	0.10	100,000	Dec. '12	0.00½
Gold King Con., g	Colo	1,000,000	1	1,417,319	Nov. '15	0.01
Golden Cycle, g	Colo	1,500,000	1	7,713,300	Jan. '17	0.03
Golden Star, g	Ariz	400,000	5	140,000	Mar. '10	0.05
Goldfield Con., g	Nev	3,559,148	10	28,999,832	Oct. '15	0.10
Good Springs Anchor, s	Nev	550,000	1	108,785	May '16	0.01
Grand Central, g	Utah	500,000	1	1,673,250	Dec. '16	0.04
Granite, g	Colo	1,650,000	1	286,500	Dec. '12	0.01
Hazel, g	Cal	900,000	1	971,000	Dec. '13	0.01
Hecla, l.s	Idaho	1,000,000	0.25	5,455,000	Jan. '17	0.15
Hercules, l.s	Idaho	1,000,000	1	11,250,000	Jan. '17	0.25
Homestake, g	S. D	251,160	100	40,850,956	Jan. '17	0.65
Horn Silver, l.s.z	Utah	400,000	25	5,682,000	June '16	0.05
Inspiration, c	Ariz	1,181,967	20	8,548,050	Jan. '17	2.00
Inter'l Nickel, com	U. S.	1,673,384	25	35,961,490	Dec. '16	1.50
Inter'l Nickel, pfd	U. S.	89,126	100	5,882,102	Nov. '16	1.50
Iowa, g.s.l	Colo	1,666,667	1	299,333	Jan. '17	0.00¾
Iowa-Tiger, g.s	Colo	3,000	1	25,179	Dec. '15	1.00
Iron Blossom, s.l.g	Utah	1,000,000	0.10	2,950,000	Jan. '17	0.10
Iron Silver, s.l.g	Colo	500,000	20	4,950,000	Dec. '14	0.10
Jamison, g	Cal	390,000	10	386,100	Dec. '15	0.01
Jerry Johnson, g	Colo	2,500,000	0.10	187,500	Nov. '14	0.01
Jim Butler-Tonopah, g.s	Nev	1,718,021	1	515,406	Aug. '16	0.10
Judge M. & S., s.l	Utah	480,000	1	1,590,000	Dec. '16	0.25
Jumbo Extension, g	Nev	1,550,000	1	685,000	June '16	0.05
Kendall, g	Mont	500,000	5	1,555,000	Apr. '16	0.10
Kennecott Cop., c	Alas	2,780,583		15,292,722	Dec. '16	1.50
Kennedy, g	Cal	100,000	100	1,831,001	Apr. '10	0.03
Klar Piquette, s.l	Wis	20,000	1	259,000	Apr. '13	0.50
Knob Hill, g	Wash	1,000,000	1	70,000	Oct. '13	0.00½
Liberty Bell, g	Colo	133,551	5	1,752,795	Sept. '15	0.20
Little Bell, l.s	Utah	300,000	1	90,000	Apr. '16	0.05
Magma, c	Ariz	240,000	5	720,000	Dec. '16	0.50
Mammoth, g.s.c	Utah	400,000	2.50	2,420,000	Dec. '16	0.10
Mary McKinney, g	Colo	1,309,252	1	1,182,398	Oct. '16	0.01
May Day, g.s.l	Utah	800,000	0.25	300,000	Dec. '16	0.02
Mexican, g.s	Nev	201,600	2.50	161,910	June '14	0.75
Miami, c	Ariz	747,114	5	9,695,783	Nov. '16	1.50
Modoc, g.s	Colo	500,000	1	275,000	Dec. '11	0.01
Mohawk, c	Mich	100,000	25	5,575,000	Aug. '16	10.00
Monarch-Mad'a, g.s.l	Colo	1,000,000	1	40,000	May '11	0.01
Montana-Tonop., s.g	Nev	921,865	1	488,588	Dec. '12	0.10
Mountain, c	Cal	250,000	25	4,216,250	May '08	0.44
National, g	Nev	750,000	1	570,000	May '11	0.10
National Lead, com	N. Y.	206,554	100	9,758,562	Dec. '16	1.00
National Lead, pf	N. Y.	243,676	100	33,058,984	Dec. '16	1.75
Nevada Con., c	Nev	1,999,457	5	27,474,122	Dec. '16	1.50
New Idria, q	Cal	100,000	5	2,230,000	Dec. '16	1.00
North Butte, c	Mont	430,000	15	13,689,500	Jan. '17	0.75
North Star, g	Cal	250,000	10	5,087,040	Dec. '16	0.50
Old Dominion, (holding)	Ariz	293,353	25	10,840,714	Dec. '16	3.50
Old Domin'n, M. & Sm	Ariz	162,000	25	8,424,000	Dec. '16	3.50

Corrected to February 1, 1917.

Mining Companies—United States—(*Continued*)

Name of Company and Situation		Shares		Dividends		
		Issued	Par	Total	Latest	Amt.
Ophir, s.g	Nev	201,600	$3	2,068,360	Jan. '12	$0.10
Opohongo, g.s.l	Utah	898,978	0.25	80,907	Jan. '13	0.02
Oroville Dredging	Cal	686,538	5	2,189,600	Dec. '16	0.12
Osceola, c	Mich	96,150	25	15,064,175	Jan. '17	6.00
Pacific Mines Corpn., g	Calif	642,000	1	276,060	Dec. '16	0.01
Parrot, c	Mont	229,850	10	7,871,839	July '15	1.63
Pearl Con., g	Wash	1,909,711	0.05	181,422	Dec. '10	0.02
Pharmacist, g	Colo	1,500,000	1	87,500	Feb. '10	0.00½
Phelps, Dodge & Co	U. S	450,000	100	60,296,527	Dec. '16	12.50
Pioneer, g	Alas	5,000,000	1	2,041,526	Oct. '11	0.03
Pittsburgh-Idaho, l	Ida	817,692	1	338,750	Jan. '17	0.05
Pittsburg Silver Peak, g	Nev	2,790,000	1	771,200	July '14	0.02
Portland, g	Colo	3,000,000	1	10,687,000	Jan. '17	0.03
Prince Con	Nev	1,000,000	2	375,000	Dec. '16	0.05
Quilp	Wash	1,500,000	1	67,500	Feb. '12	0.01
Quincy, c	Mich	110,000	25	23,537,500	Dec '16	5.00
Ray, c	Ariz	1,577,179	10	8,931,100	Dec. '16	1.00
Reorg. Booth, g	Nev	1,000,000	1	500,000	July '16	0.10
Republic, g	Wash	1,000,000	1	170,000	Nov. '12	0.01½
Rochester, l.z	Mo	4,900	100	190,846	July '12	0.50
Round Mountain, g	Nev	1,266,591	1	363,365	Aug. '13	0.04
Seven Troughs Coal., g	Nev	1,443,077	1	252,572	Apr. '16	0.02½
St. Joseph, l	Mo	1,409,466	10	13,791,560	Dec. '16	1.25
Shannon, c	Ariz	300,000	10	900,000	Nov. '16	0.50
Shattuck Arizona, c	Ariz	350,000	10	5,075,000	Jan. '17	1.25
Silver King Coalition, l.s	Utah	1,250,000	5	14,523,385	Jan. '17	0.15
Silver King Con., l.s	Utah	637,582	1	1,101,768	Dec. '16	0.15
Sioux Con., s.l.g	Utah	745,389	1	872,097	July '11	0.04
Skidoo, g	Cal	1,000,000	5	365,000	Oct. '14	0.01
Snowstorm, c.g	Ida	1,500,000	1	1,192,103	Oct. '13	0.02
Socorro, g	N. M	377,342	5	233,802	Sept. '16	0.05
South Eureka, g	Calif	299,981	1	722,870	May '16	0.07
Standard Con., g.s	Cal	178,394	10	5,274,407	Nov. '13	0.25
Stewart, s.l	Ida	1,238,362	1	2,012,314	Dec. '15	0.05
Stratton's Ind., g	Colo	1,000,000	0.30	618,625	Jan. '16	0.04
Success, z	Ida	1,500,000	1	1,125,000	July '16	0.03
Superior & Pitts., c	Ariz	1,499,792	10	10,318,569	Dec. '15	0.38
Tennessee, c	Tenn	200,000	25	5,206,250	Apr. '16	0.75
Tomboy, g.s	Colo	310,000	4.85	3,937,815	Dec. '16	0.24
Tom Reed, g	Ariz	909,555	1	2,528,648	Oct. '15	0.01
Tonopah Belm't, s.g	Nev	1,500,000	1	8,580,539	Jan. '17	0.12½
Tonopah Ext., g.s	Nev	1,282,801	1	1,784,140	Jan. '17	0.15
Tonopah of Nev., s.g	Nev	1,000,000	1	13,700,000	Jan. '17	0.10
Trimountain, c	Mich	100,000	25	1,450,000	Dec. '13	2.00
Tuoloumne, c	Mont	2,500,000	1	520,000	May '13	0.10
Uncle Sam, g.s.l	Utah	500,000	1	495,000	Sept. '11	0.05
United Cop. Min., c	Wash	1,000,000	1	60,000	Jan. '17	0.01
United Globe, c	Ariz	23,000	100	4,255,000	Dec. '16	22.00
U. S. Steel Corp., com	U. S.	5,083,025	100	257,941,614	Dec. '16	2.25
U. S. Steel Corp., pf	U. S.	3,602,811	100	420,732,690	Nov. '16	1.75
U. S. S., R. & M., com	U.S.-Mex	351,115	50	8,117,918	Jan. '17	1.25
U. S. S., R. & M., pf	U.S.-Mex	486,350	50	18,497,922	Jan. '17	0.87½
United Verde, c	Ariz	300,000	100	40,897,000	Jan. '17	1.50
Utah, s.l	Utah	100,000	10	281,860	Dec. '10	0.02
Utah, c	Utah	1,624,490	10	52,215,777	Dec. '16	3.50
Utah Con., c	Utah	300,000	5	10,275,000	Dec. '16	1.50
Valley View, g	Colo	1,000,000	1	240,000	Dec. '10	0.04
Victoria, g.s.l	Utah	250,000	1	207,500	Mar. '10	0.04
Vindicator Con., g	Colo	1,500,000	1	3,577,500	Jan. '17	0.03
Wasp No. 2, g	S. D	500,000	1	649,466	May '16	0.02½
Wellington Mines, g	Colo	10,000,000	1	1,250,000	Oct. '16	0.02
Wolverine, c	Mich	60,000	25	9,120,000	Oct. '16	6.00
Yak, s.l	Colo	1,000,000	1	2,767,685	Dec. '16	0.57
Yankee Con., g.s	Utah	1,000,000	1	167,500	Jan. '13	0.01
Yellow Aster, g	Cal	100,000	10	1,210,789	Dec. '16	0.05
Yellow Pine, l.z.s	Nev	1,000,000	1	1,943,008	Dec. '16	0.15
Yukon Gold, g	Alas	3,500,000	5	8,633,110	Dec. '16	0.07½

Canadian, Mexican and Central American Companies

Ajuchitlan, g.s	Mex	50,000	$ 5	$ 212,500	Oct. '12	$0.25
Amparo, g.s	Mex	2,000,000	1	2,060,883	Nov. '16	0.05
B. C. Copper	B. C	591,709	5	615,399	Jan. '13	0.15
Beaver Con., s	Ont	2,000,000	1	649,912	Apr. '16	0.03
Buffalo, s	Ont	1,000,000	1	2,787,000	July '14	0.05
Canadian Goldfields, g	B. C	600,000	0.10	290,000	July '14	0.001½
Chontalpan, g.s.l.z	Mex	7,000	25	61,250	May '14	0.75
Cobalt Townsite, s	Ont	45,000	1	1,042,259	May '14	0.10
Coniagas, s	Ont	800,000	5	8,440,000	Nov. '16	0.25
Con. M. & S. Co. of Can	B. C	337,112	25	3,162,044	Jan. '17	0.62½
Crown Reserve, s	Ont	1,999,957	1	6,190,849	Jan. '17	0.05
Dome Mines, s	Ont	400,000	10	1,200,000	Dec. '16	0.50
Dos Estrellas, g.s	Mex	300,000	0.50	10,335,000	Dec. '13	1.50
El Oro, g.s	Mex	1,147,500	4.85	8,947,260	July '13	0.24
Esperanza, s.g	Mex	455,000	4.85	12,013,882	July '15	0.24
Granby, s.l.c	B. C	149,985	100	6,875,259	Nov. '16	2.00
Greene Cananea	Mex	488,444	100	7,792,950	Nov. '16	2.00
Greene Con., c	Mex	1,000,000	10	14,544,400	Jan. '17	1.00
Guanajuato D., pf., s	Mex	10,000	1000	214,356	Jan. '10	3.00
Hedley Gold	B. C	120,000	10	2,063,520	Dec. '16	0.50
Hollinger, g	Ont	4,800,000	5	6,570,000	Jan. '17	0.05
Kerr Lake, s	Ont	600,000	5	6,720,000	Dec. '16	0.25
La Rose Con., s	Ont	1,498,627	5	5,761,777	Jan. '17	0.05
Le Roi No. 2, g	B. C	120,000	24.30	1,566,450	Mar. '16	0.30
Lucky Tiger-Com., g	Mex	715,337	10	3,842,814	Jan. '17	0.09
McK.-Dar. Sav. s	Ont	2,247,692	1	4,877,507	Jan. '17	0.03
Mines Co. of Am. (new)	Mex	862,658	10	4,958,600	July '13	0.12½
N. Y. & Hond. Ros., g	C. A	200,000	10	4,240,000	Jan. '17	0.50
Nipissing, s	Ont	1,200,000	5	15,540,000	Jan. '17	0.25
Penoles, s.l.g	Mex	80,000	25	6,361,688	June '13	1.25
Pinguico, pf., s	Mex	20,000	100	840,000	Oct. '13	3.00
Right of Way Mns., s	Ont	1,685,500	1	569,042	Sept. '16	0.00½
Rio Plata, s	Mex	374,518	5	345,745	Feb. '13	0.05
San Rafael, g.s	Mex	2,400	25	1,442,380	Jan. '14	0.50
San Toy, g.s	Mex	5,750,000	1	530,000	July '13	0.01
Seneca-Superior	Ont	478,884	1	1,579,817	Dec. '16	0.05
Sorpresa, g.s	Mex	19,200	20	3,979,240	Jan. '11	34.00
Stand'd Silver-Lead	B. C	2,000,000	1	2,400,000	Dec. '16	0.02½
Temiskaming, s	Ont	2,500,000	1	1,684,156	Nov. '16	0.03
Tem. & Hud. Bay, s	Ont	7,761	1	1,940,250	Nov. '14	3.00
Trethewey, s	Ont	1,000,000	1	1,111,998	Dec. '16	0.05
Wettlaufer-Lorrain, s	Ont	1,416,590	1	637,465	Oct. '13	0.05